TriPac Auxiliary Heating/Cooling Temperature Management System

TK 53036-19-MM (Rev. 1, 09/08)

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The maintenance information in this manual covers unit models:	
TriPac (900217)	
For further information, refer to:	
TriPac Operating Manual	**TK 53035**
TriPac Parts Manual	**TK 53037**
TriPac Diagnostic Manual	**TK 53024**
TriPac Installation Manual	**TK 53120**
International Components Engineering (ICE) Compressor Service Manual	**ICE No. 51068**
Diagnosing Thermo King Refrigeration Systems	**TK 5984**
Evacuation Station Operation and Field Application	**TK 40612**
Tool Catalog	**TK 5955**
Electrostatic Discharge Training Guide	**TK 40282**
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. The above manuals may be purchased from your local Thermo King dealer.	

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

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Recover Refrigerant

At Thermo King, we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

In addition, service personnel must be aware of Federal and State regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local THERMO KING dealer.

R-134a and PAG Compressor Oil

WARNING: Use only PAG-based refrigeration compressor oil in the TriPac R-134a air conditioning system. See Thermo King Parts Manual for part number.

WARNING: With HVAC systems and the use of PAG, it is very important that oil mixing does not take place. PAG and POE oil CANNOT be mixed. Mixing these oils will cause serious system contamination, especially with chlorine based refrigerants.

NOTE: When servicing Thermo King R-134a units, use only those service tools certified for and dedicated to R-134a refrigerant and PAG compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a systems. The proper compressor oil is determined by the refrigerant used and specific air conditioning application requirements. Verify both serial nameplates on the unit and compressor for correct oil to use in a particular system. Because of the many variables in oils, particularly in HVAC systems, compressors may be delivered with an oil that is not specified for the particular unit it is to be fitted to. Unless it is 100% clear it is the correct oil, Thermo King recommends the oil is changed to the correct type.

PAG oil is very hygroscopic. Only use oil taken from a fresh container.

About This Manual

Purpose

The purpose of this manual is to provide general maintenance information necessary to maintain the TriPac unit at peak operating standards. This includes safety information, unit information such as bills of material and kit numbers, general unit information, maintenance procedures and related information (such as wiring and schematic diagrams), and some diagnostic and troubleshooting information.

NOTE: This manual may cover more than one unit. Therefore, it may contain information not applicable to your unit.

Contents

This manual is organized into the following chapters:

Chapter	Purpose
Safety Precautions	Provides detailed safety information. You should be familiar with the safety precautions before working on any unit.
Model Systems and Update Matrices	These tables list the bills of material and kit options that make up your unit. Use them for the following purposes: 1. To determine if you have the right manual for your unit: the bill of material (B/M) number on your unit serial plate should match one of the bill of material numbers listed in this publication. If you cannot find your unit B/M, call TK Service for more information.) 2. To communicate with TK Service Department: If you need to call TK Service, you must know your model number so that the service representative to help you.
Specifications	Lists unit specifications.
General Description	Gives an overview description of your unit including standard and optional features, illustrations, and general heating and air conditioning information.
Operating Instructions	Provides unit operating instructions.
Maintenance Inspection Schedule	Table of routine maintenance procedures.
Maintenance Chapters	Provide detailed maintenance procedures required for your unit. (Electrical, Air Conditioning, Compressor, Engine, Structural)
Wiring and Schematic Diagrams	Wiring and Schematic diagrams applicable to the unit.

Before You Call Thermo King Service!

Who to call: Your Thermo King Service Representative.

Before you call Thermo King Service, have the following information on hand:

- Bill of Material - usually located on the unit serial plate.
- Model Number - found on frame inside the APU unit.

Blank Pages

This manual may contain blank pages at the end of chapters. This is normal. There is no information missing from the manual.

Roadside/Curbside Terminology

Roadside/Curbside terminology: These terms can be confusing because of differences between North America and Europe. Please note:

Curbside:	The side of the truck to the driver's right when the driver is in his seat and facing forward.
Roadside:	The side of the truck to the driver's left when the driver is in his seat and facing forward.

Using the Model Tables in "About this Unit"

The model tables in this section (called "About this Unit," "Model Systems and Update Matrices," or something similar) list important unit information that you will need to communicate with the Thermo King Service Department. See the table on the previous page for a description of how to use these tables.

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Safety Precautions

General Practices

DANGER: Always turn the TriPac Main Power On/Off Key on the HMI Controller OFF while refueling the truck. Fuel vapors could ignite if they come in contact with TriPac electrical or heater components.

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes (see First Aid under Refrigeration Oil).
2. Never operate the unit with the compressor discharge valve closed.
3. Keep your hands, clothing and tools clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
4. Make sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, pulley, or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants, in the presence of an open flame or electrical short, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Make sure all mounting bolts are tight and are of correct length for their particular application.
8. Do not drill holes in the unit. Holes may weaken structural components, and holes drilled into electrical wiring can cause fire or explosion.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example a truck cab, cargo or storage compartment or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
11. EPA Section 608 Certification is needed to work on refrigeration systems.

Refrigerant

Although fluorocarbon refrigerants are classified as safe refrigerants, certain precautions must be observed when handling them or servicing a unit in which they are used. When exposed to the atmosphere from the liquid state, fluorocarbon refrigerants evaporator rapidly, freezing anything they contact.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly and to maintain respiration.

- EYES: For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- SKIN: Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- INHALATION: Move victim to fresh air and use CPR if necessary. Stay with victim until arrival of emergency medical personnel.

Refrigeration Oil

Avoid refrigeration oil contact with the eyes. Avoid prolonged or repeated contact of refrigeration oil with skin or clothing. Wash thoroughly after handling refrigeration oil to prevent irritation.

First Aid

In case of eye contact, immediately flush with plenty of water for at least 15 minutes. Wash skin with soap and water. CALL A PHYSICIAN.

Low Voltage

Control circuits used in the TriPac unit are low voltage (12 volts dc). This voltage potential is not considered dangerous, but the large amount of current available can cause severe burns if shorted or grounded.

Do not wear jewelry, watches or rings when working on the unit. If these items contact an electrical circuit, severe burns may result.

CAUTION: Always disconnect power at the battery before removing or repairing electrical components. Failure to do so may result in personal injury or damage to the equipment.

Model Systems (System Designations)

Thermo King TriPac Auxiliary Heating & Cooling Temperature Management System

System Designation	System Number	BOM	Install Kit	Refrigerant	Wiring Diagram	Schematic Diagram
TriPac	900217	005019	800220	R-134a	1E36877 (Rev. 1.0 IFB) 1E40288 (Rev. 1.5 IFB)	1E36876 (Rev. 1.0 IFB) 1E40289 (Rev. 1.5 IFB)

NOTE: When calling the dealer or factory for information or parts please have the Bill of Material number for your particular unit handy.

Specifications

TriPac Engine

Engine	TK270 (Tier 2)
Fuel Type Caution: Use fuel suitable for the climate you operate in (see truck engine manufacturer's recommendations). Blending used engine oil with diesel fuel is not permitted in the TriPac system. It will plug the filters and will not allow the air heater to run properly. Thermo King reserves the right to void all warranty on the unit.	No. 2 Diesel fuel under normal conditions No. 1 Diesel fuel is acceptable cold weather fuel
Oil Capacity: Crankcase & Oil Filter w/Bypass Oil Filter	4.5 quarts (4.3 liters) Fill to full mark on dipstick. *Fill the crankcase slowly so oil will not run into the breather hose and fill up an open cylinder. Leave the dipstick out while adding engine oil to vent the crankcase.*
Oil Type*	API Type CI-4 or better multigrade oil API Synthetic Type CI-4 or better after first 1000 hours (optional) API Type CJ-4 or better multigrade oil is required for units equipped with the optional DPF (Diesel Particulate Filter)
Oil Viscosity**	5 to 104 F (-15 to 40 C): SAE 15W-40 -4 to 86 F (-20 to 30 C): SAE 10W-30
Engine RPM: No Load Operation, Compressor Clutch Disengaged Under Load Operation, Compressor Clutch Engaged	 1850 ± 25 RPM 1800 ± 25 RPM
Engine Oil Pressure	50 psig (345 kPa) at rated output. 18 psig (128 kPa) at low idle.
Low Oil Pressure Switch (Normally Closed)	15 ± 2 psig (103 ± 14 kPa)
High Coolant Temperature Switch (Normally Open): Closes Opens	 220 ± 5 F (104 ± 3 C) 190 ± 5 F (88 ± 3 C)
Coolant Temperature Switch, Optional Arctic Package (Normally Open): Closes Opens	 35 ± 11 F (1.6 ± 6.1 C) 55 ± 11 F (12.7 ± 6.1 C)
Engine Thermostat	180 to 190 F (82 to 88 C)
Coolant System Capacity***	0.6 quarts (0.6 liters)

* Thermo King synthetic oil is compatible with petroleum lubricants so there is no danger if accidental mixing occurs or if an emergency required addition of petroleum oil. Mixing is not recommended, however, since it will dilute the superior performance properties of the synthetic oil.

** Multi-viscosity weight oil with the recommended API classification may be used based on the ambient temperature. The above recommendations are written for mineral oil based lubricants.

*** Cooling system capacity may vary, depending on installation. Cooling lines carry additional coolant. 0.6 quarts (0.6 liters) is engine only.

R-134a Air Conditioning System

Compressor Model		TM-15-HD
Refrigerant Charge		1.2 lbs. (0.54 Kg) minimum, 2.0 lbs (0.9 Kg) maximum. Correct system charge varies. Correct charge will depend upon installation and refrigeration line lengths.
Compressor Oil Charge		8 oz. (236.5 ml)*
Compressor Oil Type		See Compressor Oil Specifications on following pages
Binary Switch (Prior To 9/06):		
High System Pressure Cutout:	Opens: Cut-in, Closes:	325 ± 25 psig (2241 ± 172 kPa) 230 ± 20 psig (1586 ± 138 kPa)
Low System Pressure Cutout:	Opens: Cut-in, Closes:	22.5 ± 7.5 psig (155 ± 52 kPa) 40 psig (276 kPa)
High Pressure Cutout (HPCO):	Opens: Closes:	400 ± 10 psig (2758 ± 69 kPa) 325 ± 20 psig (2241 ± 138 kPa)
Low Pressure Cutout (LPCO):	Opens: Closes:	5 ± 3 psig (34 ± 21 kPa) 20 ± 5 psig (138 ± 34 kPa)
Freezestat, Cut-out:	Opens: Cut-in: Closes	31 ± 1.5 F (-0.5 ± 0.8 C) 39.5 ± 1.5 F (4.2 ± 0.8 C)
* When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor in the unit.		

Belt Tension

	Tension New Belt
Engine/Compressor/Alternator/Idler Pulley	95 pounds force
NOTE: A deflection of 0.25" between the alternator and compressor (longest free span of belt) may be used if a gauge is not available to test tension.	

Electrical Control System

Control System Voltage		12 Vdc
Alternator		12 V 65 amp brush type integral alternator
Fuses		
Fuse Number	**Amp Rating**	**Component Protected / Circuit**
F1	30	Starter / 8S
F2	30	Glowplugs / H
F3	5	HMI Controller / —
F4	20	Cab Heater / RED
F5	5	Standby Switch / 2A
F6	1	Standby Integration / IGN
F7	40	Fuel Solenoid / 8DP
F8	7.5	Engine Switch / 8FET
F9	5	Engine Start Signal / 7X/7A

Electrical Control System (Continued)

Fuse Number	Amp Rating	Component Protected / Circuit
F10	15	Pre-cooler Fan / PCF
F11	20	Condenser Fan / 7CF
F12	20	Evaporator Fan / PWM1/PWM2/7D
F13	7.5	Compressor Clutch / 7CL
F14	5	Heater On / 26/YLW
F15	3	Voltage Sense / SEN
F16	50	Main Power / 2
F17	2	Ground / CH
F18	3	Hourmeter (Option) / 2
F19	3	Hourmeter (Option) / 8D
F20	3	Hourmeter (Option) / 26
F21	100	Supplemental Heater Contactor (Extreme Arctic Option) / SHR
F22	70	Supplemental Heater (Extreme Arctic Option) / SH
F23	30	Oil Pan Heater (Extreme Arctic Option) / OPH
FL1 (Prior To 9/06)		Fusable Link, 20 Gauge, Voltage Sensing Wire
FL2 (Prior To 9/06)		Fusable Link, 12 Gauge, APU Main Power

Electrical Components

	Current Draw (Amps) at 12.5 Vdc	Resistance— (Ohms)
Glow Plugs (Each)	4.3	2.3 ± 0.2
Starter Motor	90 to 105 (cranking)	
Condenser Fan	11.8 to 12.4	
Pre-Cooler Fan Water Temperature switch normally closed (fan off) Switch opens at 115 F (46.1 C) (fan on) Switch closes at 95 F (35.0 C) (fan off)	6.5 to 6.6	
Evaporator Blower	10.0 to 11.1	
Fuel Pump	1.1	
Fuel Solenoid: Pull In	35 to 45	0.2 to 0.3
Hold In	0.5	24 to 29
NOTE: Disconnect components from unit circuit to check resistance.		

Truck Sleeper Compartment Heater (D2)

Heat Output (±10%)	7,500 BTU/hr Boost (2.2 kW) 6,150 BTU/hr High (1.8 kW) 4,100 BTU/hr Medium (1.2 kW) 2,900 BTU/hr Low (0.85 kW)
Current at 12v (±10%)	8.3 amps - Start 2.8 amps - Boost 1.9 amps - High 1.0 amps - Medium 0.7 amps - Low
Fuel Consumption (±10%)	Boost 0.07 gal/hr (0.28 liter/hr.) High 0.06 gal/hr (0.23 liter/hr.) Medium 0.04 gal/hr. (0.14 liter/hr.) Low 0.03 gal/hr (0.10 liter/hr.)
Air Flow (±10%)	48 cfm Boost 40 cfm High 27 cfm Medium 19 cfm Low
Motor Speed	4800 ± 140 RPM - Boost 4000 ± 120 RPM - High 2800 ± 80 RPM - Medium 2000 ± 60 RPM - Low 600 ± 20 RPM - Adjustment in circulation mode with temperature sensor, internal. 0 RPM - Adjustment in fresh air mode with temperature sensor, external. 4800 ± 140 RPM - Ventilation
Operating Voltage Range	10.5 - 16 vdc
Overheat Temperature Shutdown (±10%)	240 F (115 C)
Resistance Values: Glow Plug Fuel Metering Pump Operator Control Unit Set Value Potentiometer	 0.5 ± 0.05 Ohms 10 ± 0.5 Ohms 1750-2080 ± 0.5 Ohms

Truck Sleeper Compartment Heater (D4 - Option)

Heat Output (±10%)	13,600 BTU/hr Boost (4.0 kW) 10,200 BTU/hr High (3.0 kW) 6,800 BTU/hr Medium (2.0 kW) 3,400 BTU/hr Low (1.0 kW)
Current at 12v (±10%)	8.3 amps - Start 3.3 amps - Boost 2.0 amps - High 1.1 amps - Medium 0.6 amps - Low
Fuel Consumption (±10%)	Boost 0.13 gal/hr (0.51 liter/hr.) High 0.10 gal/hr (0.38 liter/hr.) Medium 0.07 gal/hr. (0.25 liter/hr.) Low 0.03 gal/hr (0.13 liter/hr.)
Air Flow (±10%)	85 cfm Boost 69 cfm High 50 cfm Medium 30 cfm Low
Motor Speed	4400 ± 130 RPM - Boost 3600 ± 100 RPM - High 2800 ± 80 RPM - Medium 1600 ± 50 RPM - Low 600 ± 20 RPM - Adjustment in circulation mode with temperature sensor, internal. 0 RPM - Adjustment in fresh air mode with temperature sensor, external. 3600 ± 100 RPM - Ventilation
Operating Voltage Range	10.5 - 16 vdc
Overheat Temperature Shutdown (±10%)	240 F (115 C)
Resistance Values:	
Glow Plug	0.5 ± 0.05 Ohms
Fuel Metering Pump	10 ± 0.5 Ohms
Operator Control Unit Set Value Potentiometer	1750-2080 ± 0.5 Ohms

Optional Power Inverter

See Manufacturer’s Specifications	1800 Watts

Optional Extreme Arctic Package Components

	Approximate Current Draw (Amps) at 12.5 Vdc	Approximate Resistance— (Ohms)
Coolant Heater (800 Watts)	50	0.25
Oil Pan Heater (300 Watts)	19	0.65
Supplemental Heater Contactor Coil		13.5
NOTE: Disconnect components from unit circuit to check resistance.		

Specifications—Compressor Oil

COMPRESSOR OILS REFERENCE FOR THERMO KING TRIPAC AIR CONDITIONING SYSTEM			
REFRIGERANT USED	OIL VISCOSITY ISO Method	OIL TYPE	THERMO KING P/N
R-134a	100	Polyalkylene glycol (PAG 100)	203-502

CAUTION: Mixing PAG and POE oils will damage the air conditioning system.

NOTE: Because of the many variables in oils, particularly in HVAC systems, compressors may be delivered with an oil that is not specified for the particular unit it is to be fitted to. Unless it is 100% clear it is the correct oil, Thermo King recommends the oil be changed to the correct type.

CAUTION: With HVAC systems and the use of PAG, it is very important that oil mixing does not take place. PAG and POE oil CANNOT be mixed. Mixing these oils will cause serious system contamination, especially with chlorine based refrigerants.

General Description

Introduction

The Thermo King TriPac Auxiliary Heating & Cooling Temperature Management System allows drivers to reduce unnecessary truck engine idling, conserve diesel fuel and save money. TriPac provides truck engine preheating, battery charging and truck cab sleeper compartment climate control.

By using TriPac, drivers can reduce fuel cost, rest comfortably during stops and comply with local, state and federal anti-idle laws. Reducing unnecessary truck engine idling also reduces engine wear and extends engine maintenance intervals. TriPac's own diesel engine uses an automatic start/stop feature for additional fuel efficiency.

TriPac's two-cylinder diesel engine is EPA Tier 2 approved. An automotive type air conditioning compressor is used for sleeper compartment cooling. A fuel-fired air heater provides sleeper compartment heat in cold conditions. Voltage sensing automatically charges the truck batteries from TriPac's 12-volt alternator. Noise dampening construction assures quiet operation. Truck engine preheating provides easier cold-climate starts by exchanging coolant between TriPac and the truck engine. An optional inverter provides 120-volt power to operate on-board appliances.

An optional Arctic package aids truck engine startups in cold weather by sensing low coolant temperature. The TriPac is started to heat the coolant as required.

Unit Features

- Easy to operate Human Machine Interface (HMI) Controller
- Truck cab sleeper compartment cooling and heating for driver comfort in all climates
- Truck engine preheating for easy starts in cold climates
- Truck battery charging with automatic low voltage sensing
- 7.5 hp 2 cylinder diesel engine - EPA Tier II
- Thermo King TM-15-XD compressor for air conditioning
- Diesel fuel-fired sleeper compartment air heater
- 65 amp 12 VDC alternator
- Noise-dampening construction for quiet operation
- Automatic start/stop operation for maximum fuel efficiency
- Optional Standby Truck Integration
- Optional dash mounted Truck Integration Selector Switch (select normal or standby operation)
- Optional Arctic Package
- Optional Extreme Arctic Package
- Optional 12 Vdc to 120 Vac 1800 Watt inverter for on-board appliances
- Optional chrome plated exhaust pipe
- Optional stainless steel condenser shroud
- Optional Exhaust Diesel Particulate Filter (DPF)

TriPac System

The TriPac system includes several major components:

- An APU (auxiliary power unit)
- Condenser
- Evaporator
- Heater
- HMI Controller.

AMA691

Figure 1: TriPac APU

Auxiliary Power Unit

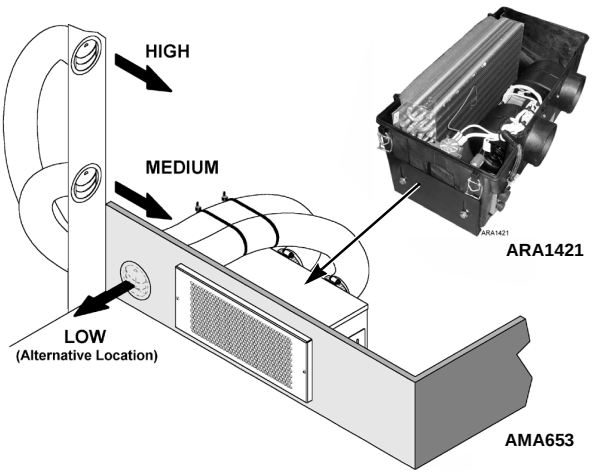
The TriPac APU contains the diesel engine, air conditioning compressor, alternator and engine power switch.

AMA550

Figure 2: TriPac Condenser

Condenser

The TriPac Air Conditioning condenser is mounted on the back of the truck cab.



AMA653

Figure 3: TriPac Evaporator and Air Ducts (Evaporator installed under sleeper cab bunk)

Evaporator

The TriPac Air Conditioning evaporator is typically installed under the bunk in the truck cab sleeper compartment. Air ducts from the Evaporator carry conditioned air to the sleeper compartment.

AMA552

Figure 4: TriPac Heater

Heater

The TriPac heater is typically installed under the bunk in the truck cab sleeper compartment. It draws fuel from the truck's diesel fuel tank and electric power from the truck's batteries.

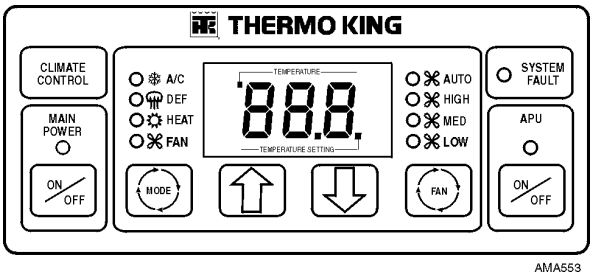


Figure 5: TriPac HMI Controller

HMI Controller

(Human Machine Interface) Controller is installed in the truck cab, typically on a wall in the sleeper compartment. It is easily accessible to the driver and controls TriPac operation. Standard, typically used operating parameters are enabled in the HMI Controller when TriPac is installed. If necessary, HMI operating parameters can be adjusted through programming by your Thermo King dealer.

Control Circuits

The control circuits operate on 12V DC supplied by the truck batteries.

Interface Board

The Interface Board is mounted in an enclosure and typically installed in a storage compartment behind or under the truck sleeper compartment. The Interface Board accepts instructions from the HMI Controller and operates TriPac components according to those instructions.

Compressor

The TriPac air conditioning compressor is mounted in the TriPac APU and is driven by the TriPac engine. Refrigeration lines connect the compressor to the TriPac air conditioning condenser on the back wall of the truck cab and the evaporator, usually mounted under the truck cab sleeper compartment bunk.

Compressor operation is controlled by the TriPac Interface Board. The Interface Board receives instructions from the HMI Controller. The HMI Controller instructs the Interface Board to start the TriPac engine and energize the compressor clutch when cab cooling is needed. On models manufactured prior to 9/06, the refrigeration system is protected by a single binary switch which combines the functions of high pressure and low system pressure cutout switches. On models manufactured during 9/06 and after, the refrigeration system is protected by a high pressure cutout switch (HPCO) and a low pressure cutout switch (LPCO).

Refrigerant

The TriPac uses R-134a refrigerant.

Protection Devices

High System Pressure Cutout Switch

The High System Pressure Cutout Switch is a normally closed system pressure sensitive switch. On models manufactured prior to 9/06, it is part of the binary pressure switch, mounted on the receiver-drier, typically near the TriPac condenser. On models manufactured during 9/06 and after, a High Pressure Cutout Switch (HPCO) is located at the receiver/drier.

If the discharge pressure rises above the switch's opening pressure, the switch opens the circuit to stop the unit and generates an AcS Alarm Code. The opening pressure for the binary switch is 325 psig (2241 kPa). The opening pressure for the HPCO is 400 psig (2758 kPa).

When the discharge pressure falls below the switch's closing pressure, the switch closes to allow compressor operation. The closing pressure for the binary switch is 230 psig (1586 kPa). The closing pressure for the HPCO is 325 psig (2241 kPa).

Low System Pressure Cutout Switch

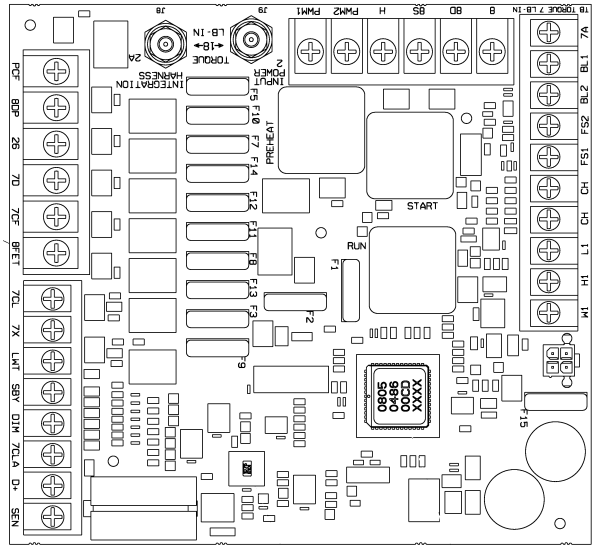
The Low System Pressure Cutout Switch is a normally closed pressure sensitive switch.

On models manufactured prior to 9/06, it is part of the binary pressure switch, mounted on the receiver-drier, typically near the TriPac condenser. On models manufactured during 9/06 and after, a Low Pressure Cutout Switch (LPCO) is installed at the evaporator coil.

If the pressure falls below the switch's opening pressure, the switch opens the circuit to stop the compressor. The opening pressure for the binary switch is 22.5 psig (155 kPa). The opening pressure for the LPCO is 5 psig (34 kPa).

When the pressure rises above the switch's closing pressure, the switch closes to allow compressor operation. The closing pressure for the binary switch is 40 psig (276 kPa). The closing pressure for the LPCO is 20 psig (138 kPa).

Fuse Protection



AMA723

Figure 6: Interface Board

The electrical system is protected by a number of fuses (see "Fuses" on page 18). Most of the fuses are located on the interface board shown above, or in the control box near the interface board.

Engine Reset Switch

The engine is protected by a reset switch. When the reset switch opens the engine will shut down. Typical causes for an open engine reset switch are low oil pressure, high water temperature or an engine start failure. The engine reset switch is located on the side of the Interface Board control box enclosure.

AMA618

Figure 7: Engine Reset Switch

Serial Number Locations

APU: Unit nameplate is located on front lower edge of APU housing frame (APU cover must be removed to view the nameplate).

Engine: Nameplate located on the top of the engine. The engine is mounted in the TriPac APU housing.

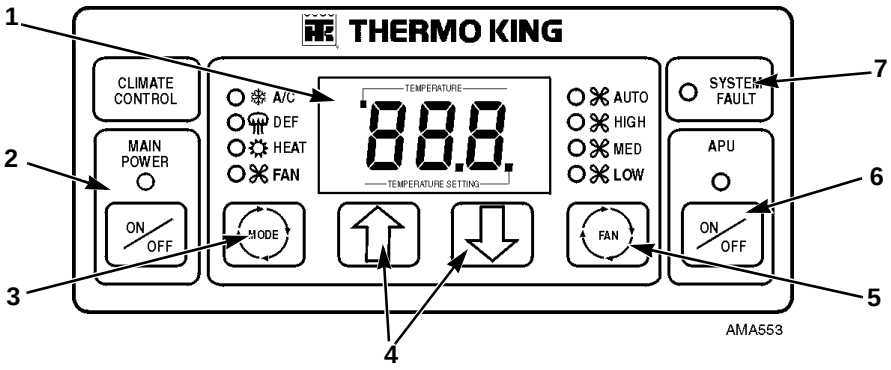
Compressor: Nameplate located on compressor body. The engine driven compressor is located in the TriPac APU housing.

Heater: Sticker located on the side of the heater (Fabrik No.).

Operating Instructions

Introduction

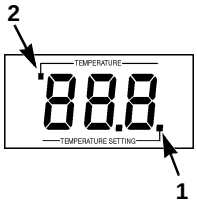
The TriPac is operated using an HMI (Human Machine Interface) Controller which is typically mounted on a wall in the truck cab sleeper compartment. The HMI Controller includes a display screen, operation keys and indicator LEDs.



1.	Display
2.	HMI Controller Main Power Key
3.	Mode Key
4.	Up and Down Keys
5.	Fan Speed Key
6.	APU Key
7.	System Fault Indicator

Figure 8: HMI Controller

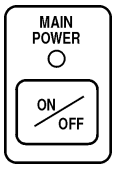
TriPac HMI Controller Description



1.	Cab Setpoint Temp LED
2.	Inside/Outside Temp LED

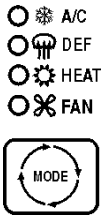
HMI Controller Display

The HMI Controller Display is used to indicate temperature setpoint, alarm codes, hourmeter reading, and other information. The LED indicator at lower right will be illuminated when the sleeper cab temperature setpoint is displayed. The LED indicator at upper left will be illuminated when the inside or outside temperature is displayed.



Main Power Key

The HMI Controller Main Power Key is used to turn the TriPac system on and off from the sleeper compartment. The green LED indicator is illuminated when the TriPac system is turned on.

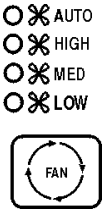


Mode Key

The HMI Controller Mode Key is used to select the desired operating mode. When the TriPac system is turned on the mode will default to the setting last used. A/C (air conditioning), Fan and Heat modes are selected by pressing the Mode key. (“DEF” is not used.) A Monitor (Null) mode will occur when no LEDs are illuminated. This allows the unit to monitor the battery voltage, and optionally the coolant temperature, without monitoring the truck cab temperature.

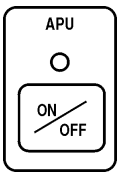
Up and Down Keys

The HMI Controller Up and Down Keys are used to raise and lower the temperature setpoint in the display. Each press of the Up or Down key will raise or lower the setpoint temperature by one degree. The display will scroll up or down if the Up or Down key is pressed continuously. The HMI Controller setpoint temperature range is 50 to 90 degrees.



Fan Speed Key

The HMI Controller Fan Speed Key is used to select the desired evaporator fan speed. When the TriPac APU system is turned on, the fan speed will default to the setting last used. High, Medium and Low fan speeds are selected with the Fan Key. Auto fan is currently not available



APU System Key

The HMI Controller APU System Key is used to enable the APU diesel power unit. The APU must be ON to provide sleeper compartment air conditioning, air circulation, truck battery voltage sensing and engine coolant temperature sensing. This key also allows access to the diesel engine hourmeter reading. The APU does not have to be On to operate the TriPac sleeper compartment heater.

System Fault Indicator

This red indicator illuminates when an alarm condition occurs and an alarm code is displayed.

Operating Modes

Air Conditioning Mode

If the HMI controller senses that the truck cab sleeper compartment temperature is 5 F above setpoint, the APU engine will start (if not already running) and the compressor clutch will engage. The A/C system will operate for at least 15 minutes after the temperature in the sleeper compartment reaches setpoint. This is to ensure that the truck battery is sufficiently charged. The APU engine will shut down if the sleeper compartment temperature setpoint and truck battery voltage have been attained (and, when the optional Arctic Package is installed, if the coolant temperature has been attained).

Heat Mode

The air heater controls the sleeper cab temperature to the setpoint entered in the HMI. If the APU is enabled, the evaporator fans can be on to circulate more air, and battery voltage sensing is enabled.

Fan Mode

The fans can be turned on for air circulation in the truck cab. Fan speed is selected and battery voltage sensing is enabled. The APU must be enabled.

Monitor (Null) Mode

The Monitor (Null) mode occurs when the HMI controller is on, the APU system is enabled and no Mode or Fan LEDs are illuminated (fans are off). Battery voltage sensing is enabled. If the optional Arctic Package is installed, coolant temperature sensing is enabled. Truck cab temperature sensing is not enabled.

Engine On/Off Switch

DANGER: Always turn the TriPac Main Power Key on the HMI Controller OFF while refueling the truck. Fuel vapors could ignite if they come in contact with TriPac electrical or heater components.

WARNING: The unit may start automatically without warning if the Engine On/Off Switch is in the On position.

WARNING: Immediately stand clear when the preheat buzzer sounds. This indicates that the engine is preheating. If the engine is hot, preheat time will only be a few seconds.

The Engine On/Off Switch is located inside the TriPac APU housing on the right side of the frame. This switch must be in the On position for the TriPac engine to operate.

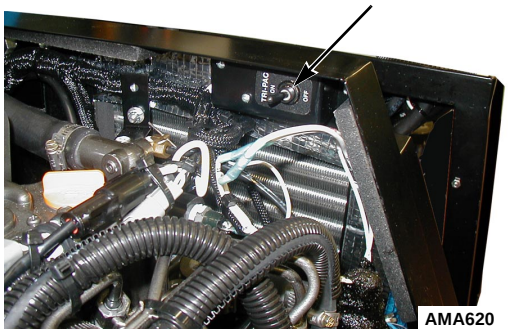


Figure 9: Early Engine On/Off Switch Location

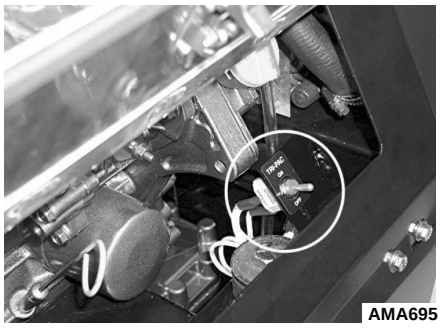


Figure 10: Later Engine On/Off Switch Location

TriPac HMI Controller Operation

Press HMI Controller Main Power Key

1. Press the Main Power Key. The green LED indicator will be illuminated when the HMI Controller is turned on.

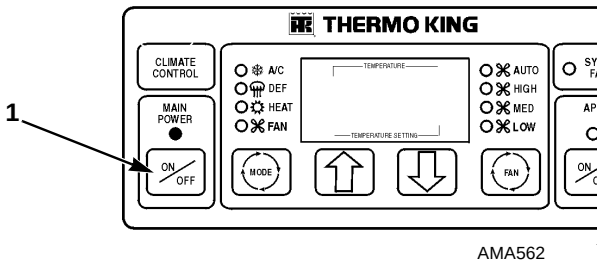


Figure 11: HMI Controller Main Power Key

Enable APU System

2. The Engine On/Off Switch (inside the TriPac APU) must be on for the engine to run. Press the HMI Controller APU Key to enable the diesel power unit and also enable sleeper compartment air conditioning, air circulation, truck battery voltage sensing and engine coolant temperature sensing. The APU Key LED will be illuminated while the APU is enabled. When the APU Key is initially pressed, the TriPac unit engine hourmeter reading will be displayed. (See next step.)

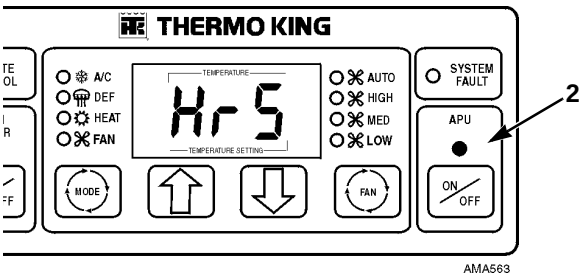


Figure 12: APU System Key

Engine Hourmeter Display

3. When the APU Key is initially pressed, the TriPac unit engine hourmeter reading will be displayed. The display will flash three screens, starting with “HrS” and followed by “tXX” for thousands of hours and then “XXX” for hundreds of hours. Example for 1,230 hours:

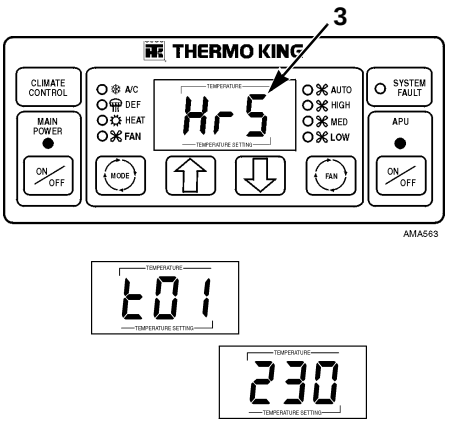


Figure 13: Engine Hour Meter Display

Select Mode of Operation

4. Press the HMI Mode Key to select the desired operating mode. Select Air Conditioning, Heat or air circulation Fan operation. (“DEF” is not used.) When the TriPac is first started, the controller will default to the previous setting. Press the Mode Key repeatedly to scroll through the selections. The operating mode selected will be indicated by an illuminated LED. A Monitor (Null) mode will occur when no LEDs are illuminated. If heat is required, the TriPac heater may operate while the TriPac APU engine is off and the HMI Fan Speed Key is off (no LED illuminated).

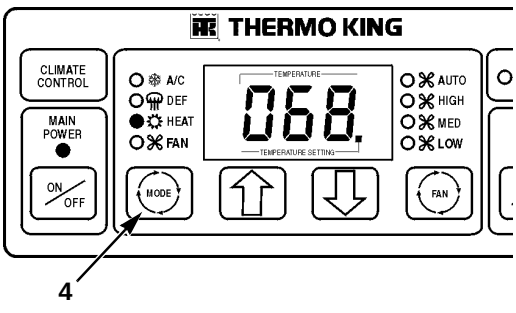


Figure 14: Mode Key

Select Fan Speed

5. Press the HMI Fan Speed Key to select the desired fan speed. Select High, Medium or Low speed. When the TriPac is first started, the HMI Controller will default to the previous setting. The fan speed selected will be indicated by an illuminated LED. (Auto fan speed is not currently used.)

   The TriPac heater will operate while the Fans are off (no fan LED is illuminated – fan is in “Null”). If additional air circulation in the truck cab sleeper compartment is desired, the fans may be turned on by enabling the APU.

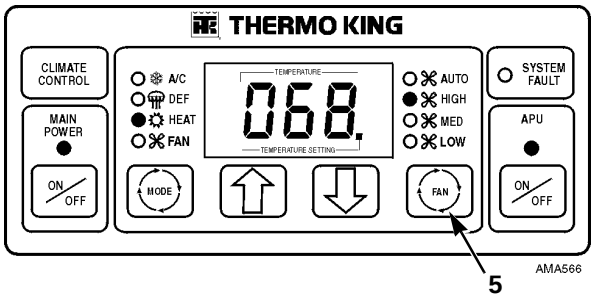


Figure 15: Fan Speed Key

Select Temperature Setpoint

6. Press the HMI Up or Down Keys to raise or lower the temperature setpoint. Each time an Up or Down Key is pressed, the display will increment up or down by one degree. If a key is pressed continuously, the display will scroll up or down. The setpoint will be changed to the value shown in the display. The HMI setpoint temperature minimum is 50 degrees and the maximum is 90 degrees.

7. The lower right LED in the HMI Display indicates that the sleeper compartment temperature setpoint is displayed.

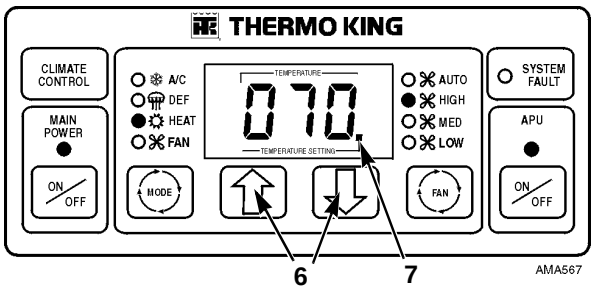


Figure 16: Up and Down Keys

System Fault Indicator

8. The HMI System Fault red indicator glows any time an alarm condition occurs and an alarm code is displayed.

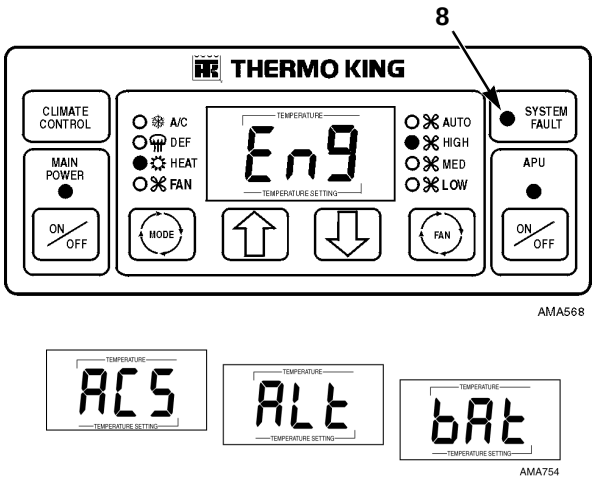


Figure 17: System Fault Indicator

Alarm Codes

TriPac HMI Controller alarm codes are:

Eng: This code indicates that the that the “8” circuit has a failure. This can be caused by an open engine reset switch or the engine compartment On/Off Switch is in the Off position. Typical causes for an open engine reset switch are low oil pressure, high water temperature or a start failure.

If the unit is equipped with the optional DPF, an [Eng] code can be generated by the Regeneration switch being placed in the “Off” position or a DPF shutdown code. Verify the DPF Regeneration switch is in the “On” position and check to see if there are any DPF alarm codes.

AcS: This code indicates that an abnormal air conditioning system condition has occurred. Typical causes are high discharge pressure or low system pressure.

ALt: This code indicates that a charging system failure has occurred. This code will occur if there is no alternator output after 2 minutes of operation.

bAt: This code indicates that the battery voltage is low.

To Clear Alarm Codes

Record the alarm code shown in the display. To clear an alarm code, use the HMI Main Power Key to turn off the TriPac system. Then resolve the condition that caused the alarm.

Check the engine reset switch. If the alarm tripped the switch, the switch must be reset to allow the TriPac engine to be restarted. The engine reset switch is located on the side of the Interface Board control box enclosure.

Optional Standby Operation

The optional TriPac HMI Controller Standby Mode allows the system to be controlled by an external source which is typically the truck’s ignition system. This is used to disable the TriPac system when the truck’s engine is running. The display will show “Sby” when the controller is in this mode. During Standby mode the controller is temporarily disabled and none of the TriPac systems will operate. Voltage sensing and the optional coolant temperature sensing functions are also disabled while in this mode.

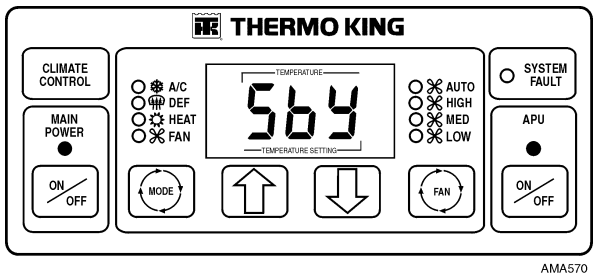
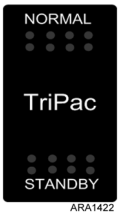


Figure 18: Standby Operation

Options Used With Standby Operation

Standby Truck Integration

When the truck's ignition switch is in the Off or Accessory position, the TriPac APU will operate normally if the APU Engine On/Off switch and the TriPac HMI Controller Main Power Key are On. If the truck's ignition switch is in the On position, the TriPac HMI Controller will be forced to Standby Mode.



Truck Integration Selector Switch

When the dash mounted Truck Integration Selector Switch is in the Normal position, the TriPac APU will operate the same as with Standby Truck Integration above. However, if the dash mounted Selector Switch is in the Standby position, the APU will be forced to Standby mode.

Maintenance Inspection Schedule

NOTE: Thermo King reserves the right to deny warranty coverage on claims due to lack of maintenance or neglect. Claims in question must be supported by maintenance records.

NOTE: See the appropriate chapter in this maintenance manual for instructions on how to correctly perform required maintenance.

Engine

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Check engine oil level.
•	•	•	Inspect belts for condition and proper tension.
•	•	•	Listen for unusual noises, vibrations, etc.
	•	•	Check air cleaner hose for damage.
	•	•	Inspect air cleaner. Change as needed or annually.
	•	•	Inspect fuel pre-filter. Change as required or annually.
		•	Change fuel filter. Thermo King brand filter is required.
		•	Drain water from fuel tank and check vent.
	•	•	Check and adjust engine speed.
	•	•	Check condition of engine mounts.
		•	Maintain year-round anti-freeze protection at –30° F (-34° C). Change coolant every two years, or with truck coolant.
		•	Adjust engine valves.

Engine Oil Change Intervals **(Change oil and filters hot)**

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
		1,000 Hour Intervals	**1,000 Hour Interval -** Oil change interval is every 1,000 hours of operation only when using a Thermo King brand oil filter and CI-4 or better oil. Units with optional DPF require CJ-4 or better oil.
		500 Hour Intervals	**500 Hour Interval -** Oil change interval is every 500 hours of operation when using any other brand oil filter and CI-4 or better oil. Units with optional DPF require CJ-4 or better oil.
			IMPORTANT: Fill the crankcase slowly so oil will not run into the breather, thus filling up a cylinder with an open valve. Leaving the dipstick out while adding oil will ventilate the crankcase.

Electrical

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
	•	•	Check operation of protection shutdown devices.
	•	•	Check alternator voltage.
		•	Check alternator bearings. See Note 1.
	•	•	Inspect battery terminals.
	•	•	Inspect electrical connections.
	•	•	Inspect wire harness for rubbing or damage.
	•	•	Check electric condenser, evaporator and pre-cooler fans.
			Note 1 - With belt removed spin alternator by hand. Listen for noise and ensure that bearings roll freely.

Structural

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Visually inspect unit for fluid leaks (coolant, oil, refrigerant).
•	•	•	Visually inspect unit for damaged, loose or broken parts.
	•	•	Inspect, clean and (if necessary) replace evaporator air filter. It may be necessary to check or replace it more often if conditions require.
	•	•	Inspect evaporator drain valves (kazoos) to ensure that they are in place, in good condition and are sealing.
		•	Steam clean condenser and APU pre-cooler coil. Do not bend coil fins.
		•	Blow out evaporator coil and evaporator water drains with air. Do not bend coil fins.
		•	Check APU mounting bolts and brackets for cracks. damage and poor aligment.Verify tightness and torque to 100 ft/lbs (135.6 N•m) for the claw mount, or 200 ft/lbs (271.2 N•m) for the direct frame mount.

A/C System

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
	•	•	Check refrigerant level.
	•	•	Check refrigerant lines for rubbing or damage.

Heater

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Start and run for at least 20 minutes each month.
•	•	•	Inspect combustion air intake tube and exhaust pipe for restrictions or blockage.
•	•	•	Inspect ducting, air intake screen, and air outlet for restrictions or blockage.
		•	Remove glow pin and inspect for carbon build up. Clean or replace.
		•	Remove glow pin screen and inspect for carbon build up. Replace.
		•	Change fuel pump screen.

Electrical Maintenance

Maintenance Inspection Schedule

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
	•	•	Check operation of protection shutdown devices.
	•	•	Check alternator voltage.
		•	Check alternator bearings. See Note 1.
	•	•	Inspect battery terminals.
	•	•	Inspect electrical connections.
	•	•	Inspect wire harness for rubbing or damage.
	•	•	Check electric condenser, evaporator and pre-cooler fans.
			Note 1 - With belt removed spin alternator by hand. Listen for noise and ensure that bearings roll freely.

WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system. Always turn off the APU Engine On/Off Switch when inspecting or servicing any components in the APU enclosure.

Alternator Charging System Diagnostic Procedures

General Information

Poor charging performance may not be caused by a bad alternator. The following conditions can cause improper battery charging, even with a good alternator. (See Service Bulletin T&T 388 for more information.)

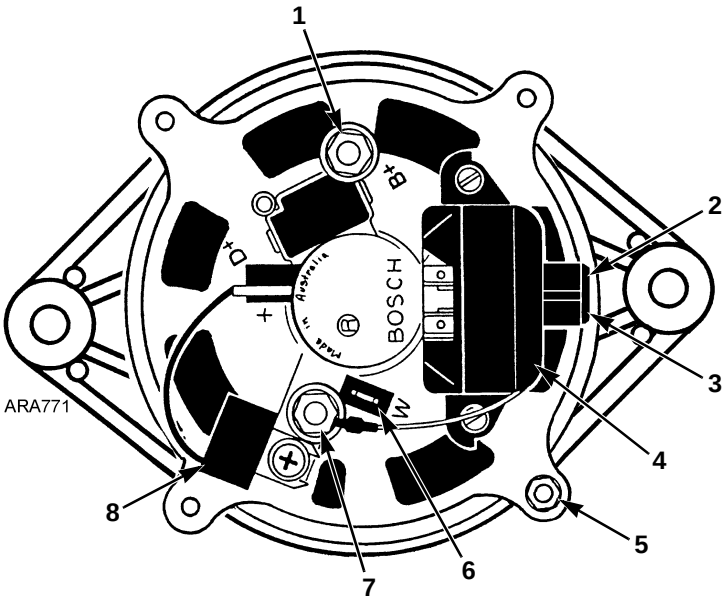
- A problem may exist in the RED output circuit from the alternator to the battery. Check for an open RED circuit, loose connections, defective battery cables or dirty battery terminals.
- The battery must be in good condition and capable of accepting a charge. Check for a damaged battery, correct electrolyte level, and loose or corroded connections.
- The alternator charging output will be low if the alternator belt or pulleys are defective or the belt is not properly adjusted. Be sure the belt is not loose or cracked and the pulleys are the correct size and in good condition. The alternator pulley nut must be tight. It should be torqued to 50 ft-lb (68 N•m).
- The excitation circuit (D+ circuit) must supply voltage to the excite terminal of the alternator.
- The sense circuit (2A circuit) must supply voltage to the sense terminal of the alternator.
- The alternator must be properly grounded.
- The unit control circuits or installed accessories may be drawing excessive current.
- An overcharged battery is usually caused by a defective voltage regulator.

Alternator Identification

Australian Bosch Alternators (see Figure 19) were used on these units until the third quarter of 2006, when the units started using Thermo King Alternators (see Figure 20).

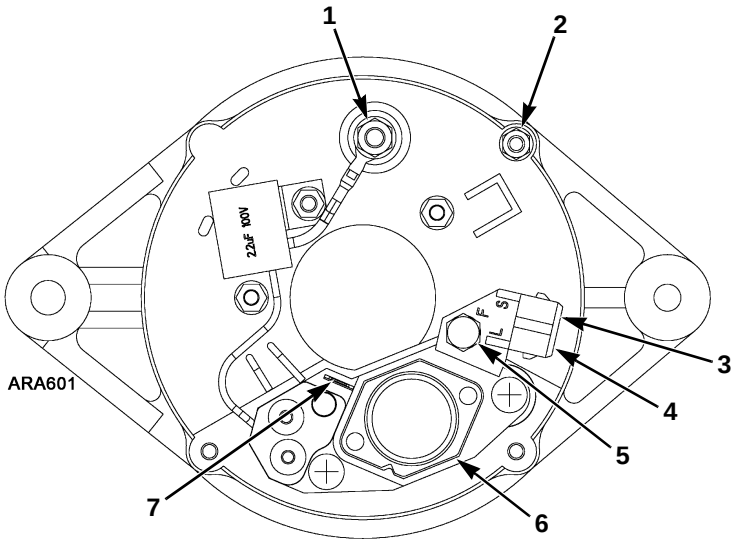
- The word “Bosch” is present on the rear bearing housing of Australian Bosch Alternators.
- Thermo King Alternators are painted black.

NOTE: The alternators used on TriPac units have counterclockwise fans. When replacing an alternator, make sure to use an alternator with counterclockwise fan.



1.	B+ Terminal (Positive Output - RED and 2 Wires)	5.	B- Terminal (Negative Ground - CH Wire)
2.	S Terminal (Regulator Sense - 2A Wire)	6.	W Terminal (AC Output)
3.	L Terminal (Regulator Excite - D+ Wire)	7.	F2 Terminal
4.	Voltage Regulator and Brush Assembly	8.	Capacitor

Figure 19: Australian Bosch Alternator Terminal and Component Locations



1.	B+ Terminal (Positive Output - RED and 2 Wires)	5.	F2 Terminal (Do Not Ground)
2.	B- Terminal (Negative Ground - CH Wire)	6.	Voltage Regulator and Brush Assembly
3.	S Terminal (Regulator Sense - 2A Wire)	7.	W Terminal (AC Output)
4.	L Terminal (Regulator Excite - D+ Wire)		

Figure 20: Thermo King Alternator Terminal and Component Locations

Test Equipment for Checking Voltage and Current

Always use accurate test equipment such as the Fluke 23 Digital Multi-Meter and the Fluke Clamp-On Ammeter accessory when checking alternator circuit voltage and amperage. See the table below for Thermo King service parts numbers. Be sure voltages are measured from the designated terminal to the alternator chassis ground. All voltages are DC voltages unless otherwise noted.

Meter	Service Part Number
Fluke 23 Digital Multi-Meter	204-1079
Clamp-On Ammeter for above Meter	204-947

Alternator Load Test

Thermo King no longer recommends a full field test for determining the alternator current output. Full fielding an alternator can cause increases in alternator output voltage that may damage internal alternator or unit components. This damage may not be readily apparent.

To test the alternator under load, Thermo King recommends the use of a clamp-on ammeter to monitor output current, both on initial startup and under full unit load conditions. For example, the APU should be turned on and operating in the A/C Mode.

General Diagnostic and Warranty Evaluation Procedure

Complete the following diagnostic procedures before replacing an alternator or the voltage regulator.

1. When testing an alternator, use accurate equipment such as a Thermo King P/N 204-1079 digital multimeter and a Thermo King P/N 204-947 amp clamp or an equivalent.
2. Make sure the drive belts and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Be sure the pulleys are the correct size. Worn belts, loose belts and worn or improperly sized pulleys will lower the output of the alternator. Make sure the alternator pulley nut is tight. It should be torqued to 50 ft-lb (68 N•m).
3. The battery must be charged and in good condition, the battery cable connections must be clean and tight, and the RED, 2, 2A (sense), and D+ (excitation) circuits must be connected properly. All charging circuit connections must be clean and secure. If the battery is questionable, a known good jumper battery should be substituted for alternator testing.

   NOTE: If the battery is questionable, a known good jumper battery should be substituted for alternator testing.

   NOTE: Do not perform this test with a battery charger connected to the battery.

   NOTE: All voltage readings should be taken between the chassis ground on the alternator and the terminals indicated, unless stated otherwise.
4. Turn the unit off by placing the TriPac HMI controller Main Power Key and APU System Key in the Off position. LEDs should be off (not lighted).
5. Check and note the battery voltage at the battery with the unit turned off.
6. With the unit off, check the voltage at the B+ terminal on the alternator. Battery voltage must be present. If not, check the 2 circuit.
7. Disconnect the alternator harness from the voltage regulator by carefully pushing on the spring clip to release the plug lock.
8. Turn the unit on by pressing the HMI Main Power Key and APU System Key to turn both On. LEDs should be on (lighted).
9. Check the voltage at the sense circuit (2A circuit). Battery voltage should be present. If not, check the sense circuit (2A circuit) in the alternator harness.

10. Check the voltage at the excitation circuit (D+ circuit). 10 Vdc or more should be present with the run relay energized (fuel pump on). If not, check the excitation circuit (D+ or equivalent circuit) in the alternator harness and in the main wire harness.
11. Turn the unit off and reconnect the alternator harness.
12. Attach a clamp-on ammeter around the RED, 2, and 2A wires connected to the B+ terminal on the alternator. All wires connected to the B+ terminal must pass through the clamp-on ammeter.
13. Connect a digital multi-meter between the B+ terminal at the alternator and chassis ground.
14. Turn the unit on and allow it to start. Using the clamp-on ammeter, check the current flow in the RED, 2, and 2A wires.

    A positive reading indicates the alternator is charging. On unit startup, the current flow should momentarily increase to allow for battery current used during preheat and cranking. Within a short time the current should fall to normal unit load plus charge current to the battery.

    A reading on the clamp-on ammeter at or near 0 amps indicates the alternator is not charging. The alternator is defective if there are no problems in the wiring. Recheck the wiring before assuming the alternator is defective.
15. Check the voltage at the B+ terminal. The voltage should increase until it reaches the anticipated voltage regulator setting as shown in the table below. Record the voltage.

    The voltage regulator setting varies inversely with the temperature as shown below. Regulator voltage can vary from approximately 15.2 Vdc at -40 F (-40 C) to approximately 13.2 Vdc at 176 F (80 C).

Temperature	Anticipated Regulator Voltage
-40 F (-40 C)	From 15.2 Vdc to 14.0 Vdc
77 F (25 C)	From 14.4 Vdc to 13.6 Vdc
176 F (80 C)	From 14.2 Vdc to 13.2 Vdc

    If the voltage does not increase to the anticipated voltage regulator setting, the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.
16. If the voltage does increase until it reaches the anticipated voltage regulator setting, compare the voltage at the B+ terminal to the voltage between the battery terminals. The voltage at the B+ terminal should be no more than 1.0 Vdc higher than the voltage between the battery terminals.

    If the voltage at the B+ terminal is no more than 1.0 Vdc higher than the voltage between the battery terminals, continue with step 17.

    If the voltage at the B+ (POS) terminal is more than 1.0 Vdc higher than the voltage between the battery terminals, clean and check the wires and connections in the 2 and 2A circuits and repeat this check.
17. Increase the charging system load as much as possible by running the unit in the A/C Mode.
18. Monitor the alternator output voltage.

    With the increased load, the alternator output voltage should decrease no more than 0.5 Vdc. The voltage may increase as much as 1.0 Vdc. If the alternator output voltage decreases no more than 0.5 Vdc the alternator is good.

    If the alternator output voltage decreases more than 0.5 Vdc, the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.

Alternator Diode Quick Check:

This check confirms proper diode function.

19. With the unit still running, set the digital multi-meter connected from the alternator B+ output to chassis ground for AC volts. No more than 1.0 Vac should be present. A reading of more than 1.0 Vac indicates damaged alternator diodes.
20. Turn the unit off.

Field Current Test

Use this test to determine if the alternator can be repaired. Perform this test with the unit turned off.

1. Attach a clamp-on ammeter to the 2A wire near the B+ terminal on the alternator.
2. Energize the field:
   - On the Australian Bosch alternator, connect a jumper wire between the F2 terminal on the alternator and a chassis ground.
   - On the Thermo King alternator, connect a jumper wire between the F2 terminal and the B+ terminal. Do not connect the F2 terminal to ground or the alternator will be damaged.
3. Note the ammeter reading. The ammeter reading indicates the field current, which should be 2.0 to 5.0 amps at 12 volts.
   - No field current or a low field current indicates an open circuit or excessive resistance in the field circuit. Remove the voltage regulator and brush assembly and inspect the slip rings. If the slip rings and are acceptable, install a new voltage regulator and brush assembly and repeat the test. If the brushes are not the problem, replace the alternator.
   - High field current indicates a short in the field circuit. Replace the rotor or the alternator.

Glow Plugs

Glow plugs heat the combustion chamber to aid in quick starting. The glow plugs are energized when the TriPac system is on and the TriPac controller senses that a startup is required. After the glow plugs preheat, the TriPac engine will be started. If the engine is hot, preheat time will only be a few seconds.

An open glow plug (burned out) can be detected with an ammeter in the H circuit. The ammeter should show 7.0 to 8.5 amps during preheat. A current draw of 7.0 to 8.5 amps means the glow plugs are working. If the current draw drops below 7 amps during preheat, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the H wires and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of 2.3 ohms or a current draw of about 4.3 amps.

A shorted glow plug will be indicated by the ammeter showing a very high current draw when the TriPac is preheating. Check each glow plug. A shorted glow plug will have very low resistance.

High Coolant Temperature Sensor

The High Coolant Temperature Sensor will close and trip the reset switch if the coolant temperature is greater than 220 F (104 C). Use a continuity tester to check the sensor, and use a coolant temperature gauge to check the temperature.

1. Remove the 20 wire from the sensor.
2. Run the unit until it reaches normal operating temperature, approximately 180 F (82 C). There should be no continuity from the sensor to ground.
3. If you suspect the engine is running hot and the sensor is not closing, run the unit until the coolant temperature reaches 220 F (104 C). The sensor should have continuity to ground.

Replace the sensor as necessary.

Low Oil Pressure Switch

The engine oil pressure should rise immediately after the engine is started. The Low Oil Pressure Switch will trip the engine reset switch and stop the engine if the oil pressure drops below 15 ± 2 psig (103 ± 14 kPa). A continuity tester is needed to check the Low Oil Pressure Switch.

1. Remove the 20 wire from the Low Oil Pressure Switch.
2. The continuity tester should indicate a complete circuit between the terminal and ground.
3. Start the engine. The tester should show an open circuit between the terminal and ground.

The Low Oil Pressure Switch is not repairable. It must be replaced if it does not function properly.

Condenser and Pre-cooler Axial Fan Motors

NOTE: A non-repairable plastic fan motor assembly is used. If this motor malfunctions, it must be replaced.

CAUTION: Take precautions to ensure the unit will not accidently start while servicing the system.

The condenser fan and pre-cooler axial fan motors are maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured while proper voltage is applied. The current draw for the motor is:

- Condenser fan motor: 11.8 to 12.4 amps ± 10% with 12.5 volts
- Pre-cooler fan motor: 6.5 to 6.6 amps ± 10% with 12.5 volts

Axial Fan Motor Removal and Installation

Removal

1. Turn the TriPac unit off.
2. Disconnect the motor power plug.

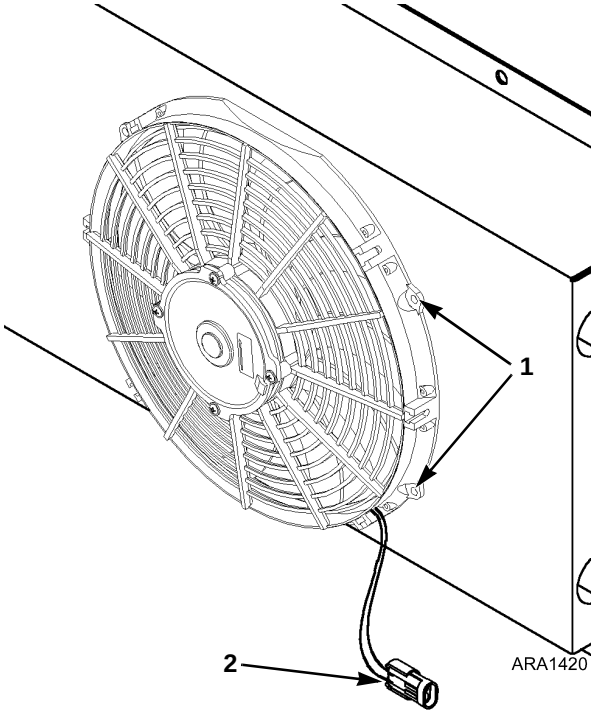
NOTE: Motor is attached to orifice access panel frame.

3. Remove fan motor mounting bolts (4) from the orifice access panel.
4. Remove axial fan motor from unit.

Installation

1. Attach the axial fan motor to orifice panel. Securely tighten fan motor mounting bolts (4).
2. Connect the motor power plug.
3. Start the TriPac and verify correct motor operation.
4. If the unit is operating properly, return the TriPac to service.

CAUTION: Fans are polarity sensitive. If not properly connected, the fan may run backwards.



1.	Mounting Holes (4)
2.	Power Plug

Figure 21: Axial Fan Motor

Evaporator Blower Motor

CAUTION: Take precautions to ensure the unit will not accidentally start. while you are servicing the system.

The evaporator blower motor is maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured. The current draw for the motor is 10.0 to 11.1 amps at 12.5 volts, with a rating tolerance of ± 10%.

Evaporator Blower Motor Removal and Installation

Removal

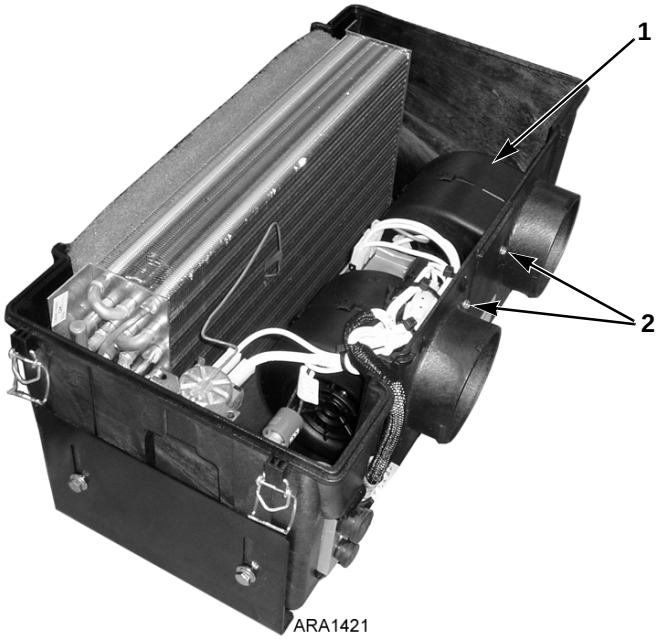
NOTE: The motor and housing are replaced as a unit. No repair is possible to the motor itself.

1. Turn the TriPac unit off.
2. Disconnect the power plug from the motor.
3. Unscrew the screws attaching the motor housing to the evaporator frame and remove the blower housing from the unit.

Installation

1. Position the motor assembly on the frame.
2. Align and replace the motor assembly mounting screws in the frame. Securely tighten all the mounting screws.
3. Connect the power plug to the motor.
4. Start the TriPac and verify correct motor operation.
5. If the unit is operating properly, return the TriPac to service.

CAUTION: The blower motor is polarity sensitive. If not properly connected, the blower may run backwards.



1.	Blower
2.	Mounting Screws (2)

Figure 22: Evaporator Assembly (Cover Removed)

Engine Maintenance

Maintenance Inspection Schedule

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Check engine oil level.
•	•	•	Inspect belts for condition and proper tension.
•	•	•	Listen for unusual noises, vibrations, etc.
	•	•	Check air cleaner hose for damage.
	•	•	Inspect air cleaner. Change as needed or annually.
	•	•	Inspect fuel pre-filter. Change as required or annually.
		•	Change fuel filter. Thermo King brand filter is required.
		•	Drain water from fuel tank and check vent.
	•	•	Check and adjust engine speed.
	•	•	Check condition of engine mounts.
		•	Maintain year-round anti-freeze protection at –30° F (-34° C). Change coolant every two years, or with truck coolant.
		•	Adjust engine valves.

Engine Oil Change Intervals (Change oil and filters hot)

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
		1,000 Hour Intervals	**1,000 Hour Interval -** Oil change interval is every 1,000 hours of operation only when using a Thermo King brand oil filter and CI-4 or better oil. Units with optional DPF require CJ-4 or better oil.
		500 Hour Intervals	**500 Hour Interval -** Oil change interval is every 500 hours of operation when using any other brand oil filter and CI-4 or better oil. Units with optional DPF require CJ-4 or better oil.
			IMPORTANT: Fill the crankcase slowly so oil will not run into the breather, thus filling up a cylinder with an open valve. Leaving the dipstick out while adding oil will ventilate the crankcase.

CAUTION: Use fuel suitable for the climate you operate in (see truck engine manufacturer's recommendations). Blending used engine oil with diesel fuel is not permitted in the TriPac system. It will plug the filters and will not allow the air heater to run properly. Thermo King reserves the right to void all warranty on the unit.

Engine Lubrication System

The TriPac diesel engine has a pressure lubrication system. Oil is circulated by a trochoid type oil pump driven by the crankshaft timing gear and has several times the capacity required by the engine. Oil is picked up through a suction tube with a screened inlet. Oil to the rocker arm shaft flows through a tube on the outside of the engine and into the head through a restrictor fitting.

Oil pressure is affected by oil temperature, viscosity and engine speed. Subnormal oil pressures usually may be traced to lack of oil, faulty relief valve or worn bearings. The use of improper viscosity oil will also produce low oil pressure shutdowns.

Engine Reset Switch

The engine is protected by a reset switch. Typical causes for an open engine reset switch are low oil pressure, high water temperature or an engine start failure. The engine reset switch is located on the side of the Interface Board control box enclosure.

NOTE: To check the operation of the engine reset switch, ground the 20 circuit to the engine reset switch while the engine is running. The engine reset switch should trip (open) and stop the engine in approximately one minute or less.

Figure 23: Engine Reset Switch

Engine Oil Change

The engine oil should be changed according to the "Maintenance Inspection Schedule." Drain the oil only when the engine is hot to ensure that all the oil drains out. When changing oil, try to make sure that the unit is not tipped away from the direction that the oil is supposed to flow out of the oil pan. It is important to drain as much of the residual oil as possible because most of the dirt particles are in the last few quarts of oil that are drained from the oil pan. Refill the oil pan (refer to the "Specifications" chapter) and check the oil level.

NOTE: Fill the crankcase slowly so oil will not run into the breather and fill up a cylinder with an open valve. Leave the dipstick out while adding oil to ventilate the crankcase.

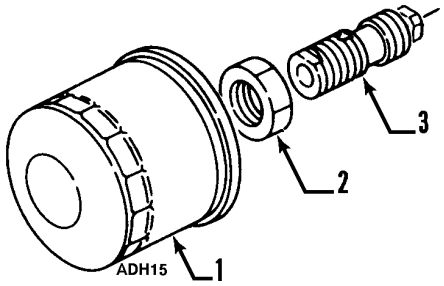
Run the unit, and then recheck the oil level. Add oil as necessary to reach the full mark on the dipstick. See the Specifications page for the correct type of oil.

Oil Filter Change

The oil filter should be changed along with the engine oil.

Spin-on Filter:

1. Remove the filter.
2. Apply oil to rubber ring of new filter and install filter.
3. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.



1.	Spin-on Oil Filter
2.	Pressure Valve Nut
3.	Oil Pressure Valve

Figure 24: Oil Filter Parts

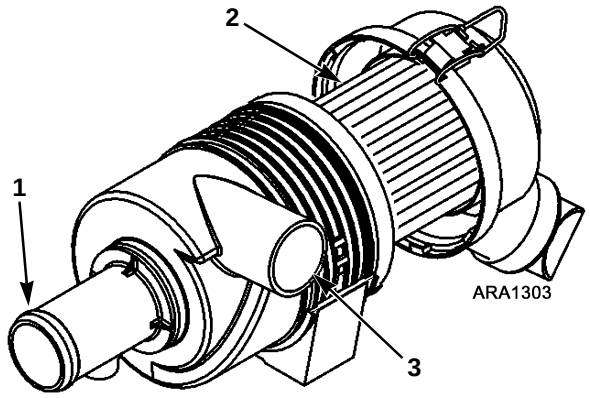
Crankcase Breather

The crankcase breather system ducts crankcase gases formed in the crankcase directly to the intake. Harmful vapors that would otherwise collect in the crankcase and contaminate the oil or escape to the outside, are now drawn back into the engine and burned. The breather should be inspected yearly to make sure it is not plugged.

Engine Air Cleaner

The air cleaner uses a dry element. The air cleaner filters all of the air entering the engine. Excessive restriction of the air intake system affects horsepower, fuel consumption and engine life. Inspect the element at every oil change.

At a minimum of once per year, inspect for small animal/insect nests to ensure full filter element integrity. (Replace filter if there is any evidence of animal ingress.) Clean by blowing clean, dry compressed air from inside filter element. Replace air cleaner element as needed or at least every 2,000 hours or 1 year of normal use (whichever occurs first). The HMI displays TriPac engine operation hours when the APU System key is pressed on APU startup.



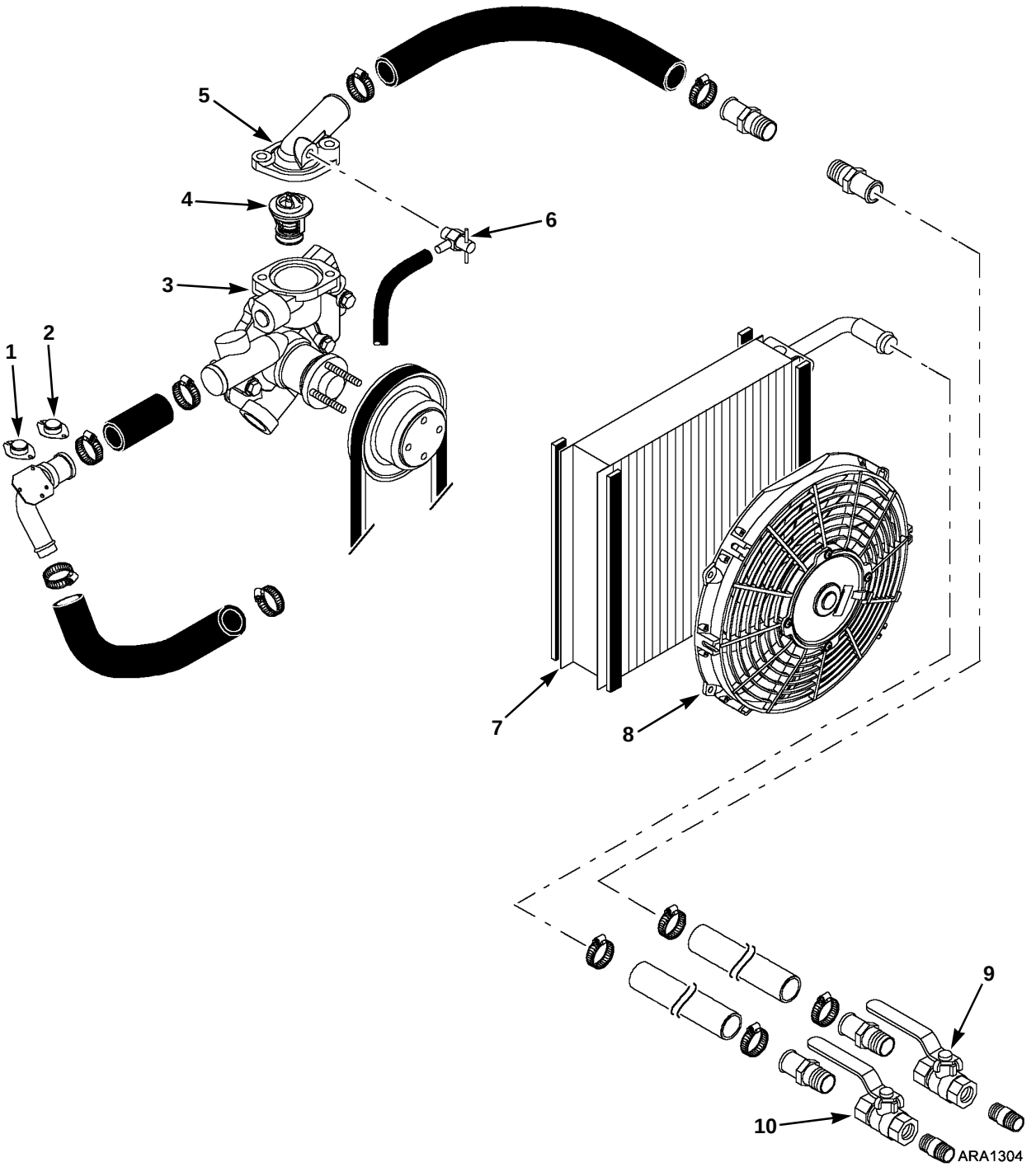
1.	Output Connection to Engine Intake
2.	Dry Filter Element
3.	Intake Hose Connection

Figure 25: Air Cleaner

Engine Cooling System

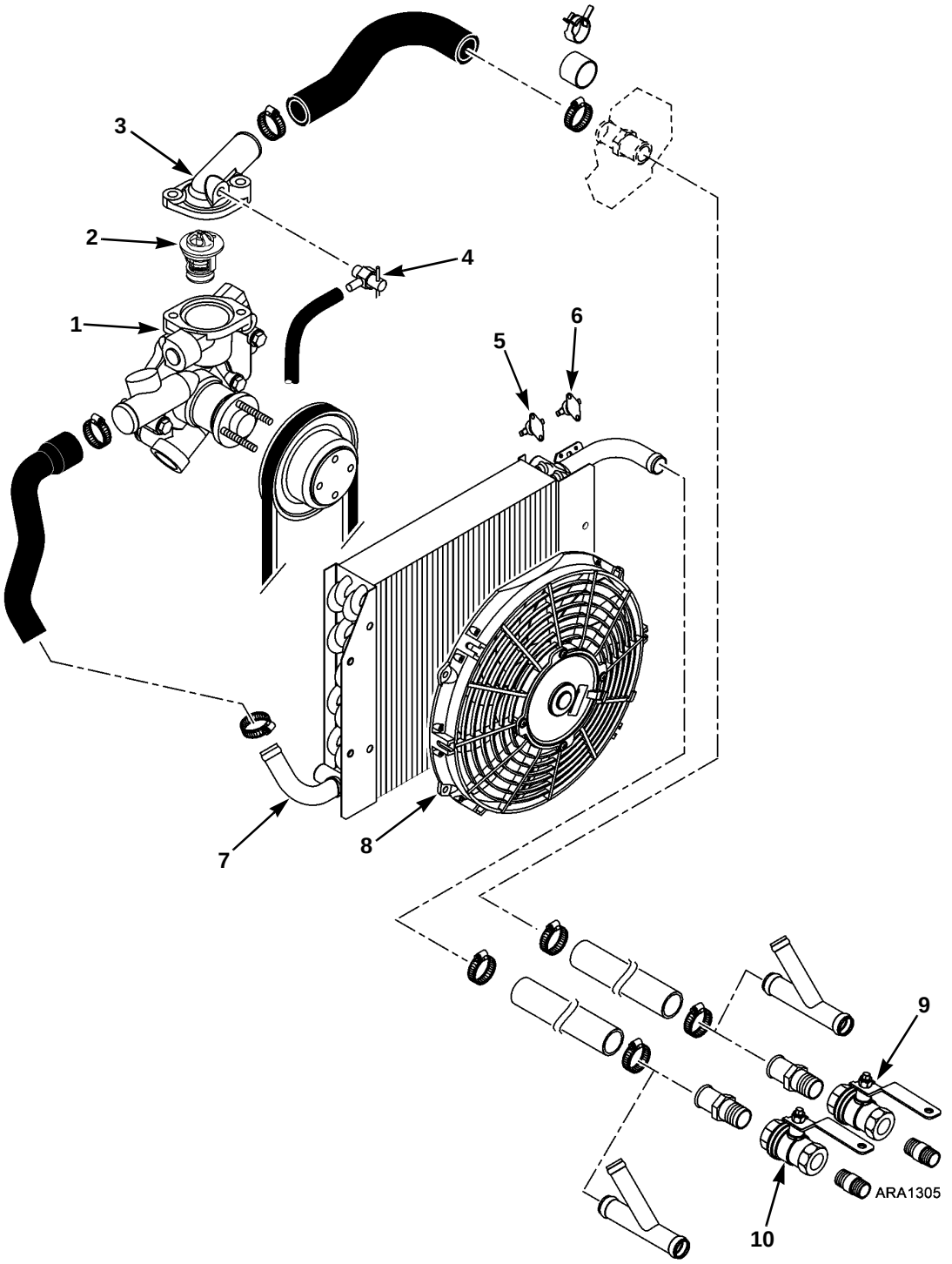
The engine employs a closed, circulating type, pressurized cooling system. Correct engine temperatures are controlled and maintained by the truck engine cooling system, TriPac pre-cooler, and TriPac engine thermostat. The coolant is circulated through the TriPac engine by a belt-driven centrifugal pump. The pump draws coolant from the truck engine, through the pre-cooler, circulates it through the TriPac engine cylinder block and head, and then sends it to back the truck engine block through a coolant hose. A thermostat is mounted in the water outlet from the TriPac engine cylinder head to the truck engine.

The pre-cooler fan will turn on if the coolant entry temperature exceeds 120 F (49 C) and will turn off when the coolant entry temperature falls below 105 F (40 C).



1.	Coolant Temperature Switch - Arctic Option	6.	Bleed Valve
2.	Water Temperature Switch - Pre-Cooler Fan Switch	7.	Pre-Cooler Coil
3.	Water Pump	8.	Pre-Cooler Fan
4.	Thermostat	9.	Ball Valve, Coolant Hose (Outlet, back to truck engine)
5.	Thermostat Cover	10.	Ball Valve, Coolant Return Hose (Inlet, coolant from truck engine)

Figure 26: Engine Cooling System Components, Before 10/06



1.	Water Pump	6.	Coolant Temperature Switch - Arctic Option
2.	Thermostat	7.	Pre-Cooler Coil
3.	Thermostat Cover	8.	Pre-Cooler Fan
4.	Bleed Valve	9.	Ball Valve, Coolant Hose (Outlet, back to truck engine)
5.	Water Temperature Switch - Pre-Cooler Fan Switch	10.	Ball Valve, Coolant Return Hose (Inlet, coolant from truck engine)

Figure 27: Engine Cooling System Components, 10/06 and After

Antifreeze Maintenance Procedures

As with all equipment containing antifreeze, periodic inspection on a regular basis is required to verify the condition of the antifreeze. Inhibitors become worn out and must be replaced by changing the antifreeze.

TriPac shares coolant with the truck engine. The APU is equipped with inlet and outlet coolant fittings. Coolant from the APU is routed to the truck engine where it is circulated through the engine block and returned back to the APU's pre-cooler.

A coolant hose is routed from the outlet fitting of the APU to the inlet side of the water pump located on the truck's engine. Another coolant hose is routed from the truck's heater outlet to the APU's pre-cooler inlet.

APU coolant hoses allow shutoff valves to isolate the APU cooling system from the truck's cooling system.

Engine coolant checks and maintenance should follow the truck engine manufacturer's recommendations. (See Caution statement below.)

CAUTION: Avoid direct contact with hot coolant.

CAUTION: Do not remove the radiator cap while the engine is hot.

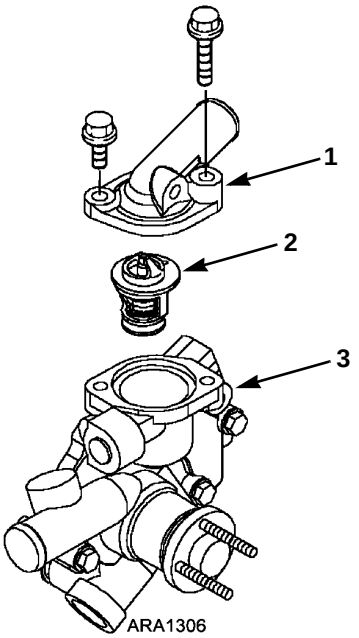
CAUTION: Do not mix engine coolant types. The original TriPac installation was adapted to the coolant used in the truck engine at the time of installation. Before coolant is added or replaced, make certain that the coolant type and specifications are correct.

TriPac Engine Coolant Maintenance Checks:

- Inspect all the hoses for deterioration and hose clamp tightness. Replace if necessary.
- Loosen the water pump belt. Check the water pump bearing for looseness.

Engine Thermostat

For best TriPac engine operation, use a 180 F (82 C) thermostat in the TriPac engine year round.



1.	Thermostat Housing
2.	Thermostat
3.	Water Pump

Figure 28: Water Pump Assembly and Thermostat

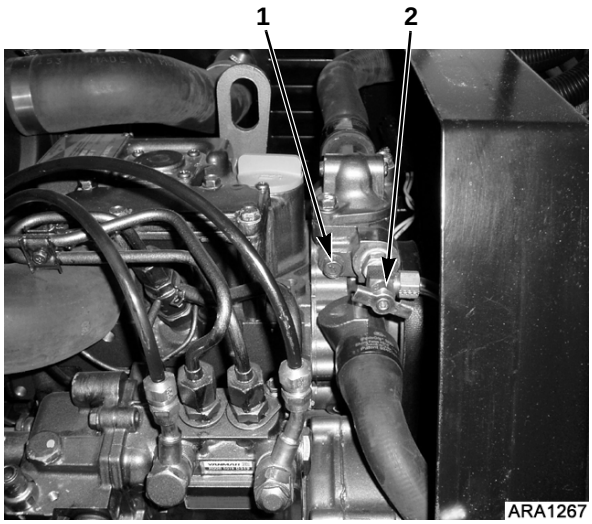
Bleeding the Coolant System

Often when a TriPac unit cooling system is refilled, air is trapped in the engine block and/or under the thermostat. Use the following procedure to bleed air out of the block and the cooling system:

NOTE: If an engine runs with air trapped in the block, the engine may be damaged. The high water temperature switch may not protect an engine that has air trapped in the block, because the high water temperature switch is designed to protect an engine from overheating due to failures in the cooling system and the loss of coolant.

CAUTION: Do not start the engine without bleeding the air out of the block.

1. Verify the TriPac OUTLET hand valve is CLOSED (tractor inlet, next to water pump). If this valve is left open, coolant will be sitting on top of the TriPac thermostat and not allow the TriPac engine to bleed air.
2. Open the TriPac INLET hand valve.
3. Place clean container under the TriPac bleed line to catch coolant that is drained.
4. Open bleed petcock on the TriPac engine to allow air to bleed out.



1.	Water Pump Bleeder Bolt
2.	Bleed Petcock

Figure 29: Water Pump Bleeder Bolt and Bleed Petcock Locations

NOTE: Units built prior to September 2006 have the bleed petcock on the top of the thermostat housing. On these units, remove the water pump bleeder bolt and bleed the air until there is a steady stream of coolant. Then reinstall the water pump bleeder bolt.

5. When a steady stream of coolant flows from the bleed line, close the bleed petcock.
6. Open the TriPac OUTLET hand valve.
7. Replace drained coolant from the TriPac back into the truck's radiator.
8. Start the TriPac engine and use a non-contact thermometer pointed at the water pump bleeder bolt to monitor the coolant temperature. The water pump bleeder bolt located next to the bleed petcock on the water pump (see Figure 29).

CAUTION: Do not start the TriPac engine before a partial refrigerant charge has been added or damage to the A/C compressor will result.

9. When the temperature reaches 170 F (76 C), shut off the engine for 2 minutes to allow the thermostat to heat soak and open completely to purge air out of block, head, and water pump.
10. After 2 minutes, re-start the engine. The remaining air in the system will be forced to the truck radiator and the TriPac APU should now be bled of all air.

Engine Fuel System

CAUTION: Use fuel suitable for the climate you operate in (see truck engine manufacturer's recommendations). Blending used engine oil with diesel fuel is not permitted. The fuel filter may become plugged and require replacement before the TriPac will operate.

The fuel system used on the Thermo King TriPac diesel is a high pressure system used in conjunction with a prechamber.

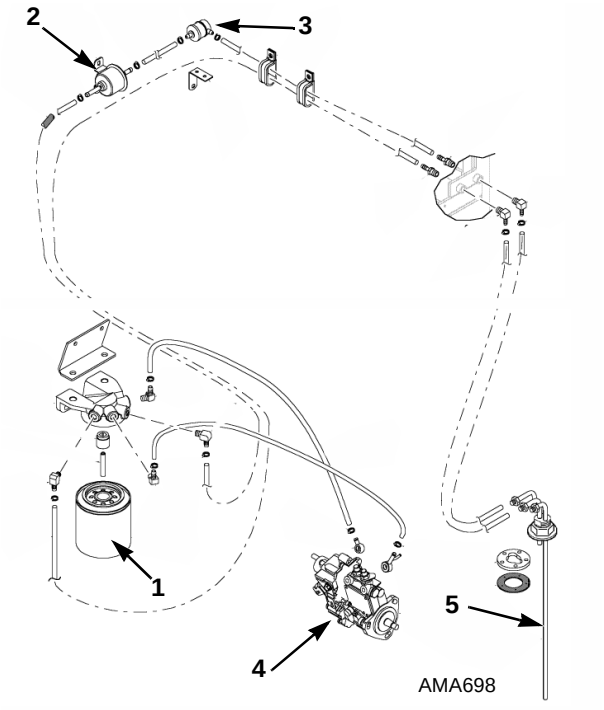
The components of the fuel system are:

- Fuel tank (the truck fuel tank)
- Fuel pre-filter
- Electric fuel pump, in-line
- Fuel filter
- Injection pump
- Injection nozzles.

An electric fuel pump pulls fuel from the fuel tank through an in-line fuel filter, then pushes it to the fuel filter, and to the injection pump.

The fuel system is relatively trouble free. If properly maintained it will usually not require major service repairs between engine overhauls.

The most common cause of fuel system problems is contamination. It cannot be stressed enough that the fuel must be clean, fuel tanks must be free from contaminants, and the fuel filter must be changed regularly. Any time that the fuel system is opened up, all possible precautions must be taken to keep dirt from entering the system. This means all fuel lines should be capped when open. The work should be done in a relatively clean area, if possible, and the work should be completed in the shortest time possible.



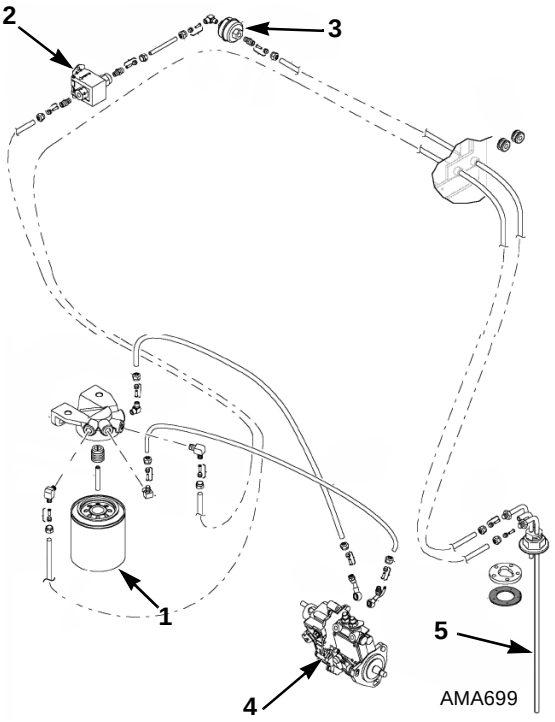
1.	Fuel Filter
2.	Electric Fuel Pump, In-line
3.	Fuel Pre-filter, In-line
4.	Fuel Injection Pump
5.	Fuel Pickup Tube

Figure 30: Engine Fuel System, Rubber Fuel Lines

Thermo King strongly recommends that any major injection pump or nozzle repairs be done by a quality diesel injection service specialty shop.

The following procedures can be done under field conditions:

- Bleeding air from the fuel system
- Maintenance involving the fuel tank and filter system
- Engine speed adjustment
- Electric fuel pump replacement
- Injection line replacement
- Injection pump timing
- Injection nozzle testing, adjustment, and minor repair



1.	Fuel Filter
2.	Electric Fuel Pump, In-line
3.	Fuel Pre-filter, In-line
4.	Fuel Injection Pump
5.	Fuel Pickup Tube

Figure 31: Engine Fuel System, Nylon Fuel Lines

Bleeding the Fuel System

The fuel system will have to have the air bled out if the engine runs out of fuel, if repairs are made to the fuel system or air gets into the fuel system for any other reason. HMI Controller code [Eng] will be displayed if the engine fails to start due to lack of fuel.

Proceed as follows:

1. Open the fuel return line banjo fitting to bleed fuel from the line.

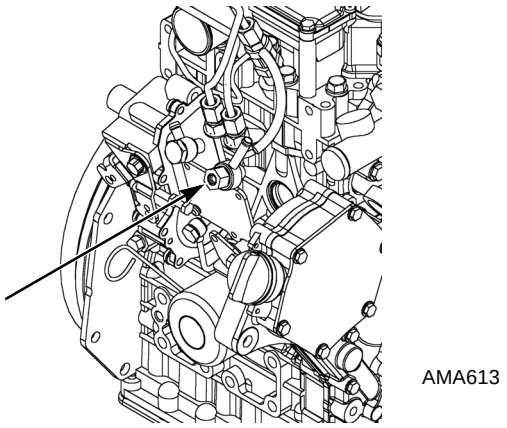


Figure 32: Fuel Return Line Banjo Fitting

2. Set the TriPac HMI to a setting that will cause the TriPac engine to attempt to start. For example, select a temperature (such as 50 F) that will cause the HMI to enter an air conditioning cycle and signal an engine start.

NOTE: Several repeat attempts may be required to complete this procedure. The engine will attempt to start for a maximum of 30 seconds. If it does not start, the HMI will display fault code [Eng] and the engine start sequence will end. If the procedure describe here is not successful after the third attempt, there may not be an adequate amount of fuel present to support an engine start. Check the fuel supply in the tank and also inspect fuel lines for leaks.

3. The engine will crank. The fuel pump will run only when the engine is cranking.
4. Repeat Steps 1 and 2 followed by Steps 4 and 5 until an adequate amount of fuel is exiting the fuel return line. This indicates that all air has been bled from the line.
5. Stop the engine start sequence by turning off the HMI Controller. If the Engine Reset Switch trips, reset it.
6. Close the fuel line banjo fitting and retighten.
7. With air bled out of the fuel line, the engine should now be capable of starting. Turn on the HMI and repeat Step 4 to test the engine.

Water in the Fuel System

Water in the fuel system can damage the injection pump, nozzles and prechamber. This damage will subsequently cause more expensive damage to the engine. A large accumulation of water in the bottom of the fuel tank will stop a diesel engine. Water should be drained off periodically to avoid breakdowns. TriPac draws its fuel from the truck's fuel tank. Follow the truck manufacturer's procedures for removing water from the truck fuel tank.

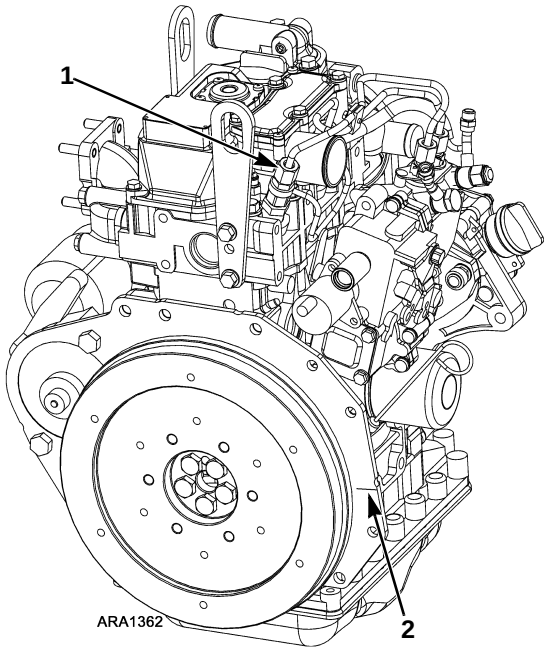
Fuel Filter Replacement

1. Remove the filter and discard.
2. Lubricate rubber ring of new filter with fuel.
3. Install the filter and tighten until the filter is slightly loose (rubber ring not making contact).
4. Bleed the air from the filter by operating the electric pump until fuel bubbles appear at the top of filter.
5. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.

Injection Pump Timing

This timing procedure requires fuel pressure at the injection pump inlet. This is be accomplished by using the electric fuel pump to supply fuel to the fuel pump inlet.

CAUTION: The cylinders on the engine are numbered from the flywheel end to the water pump end. The number 1 cylinder is next to the flywheel and the number 2 cylinder is next to the water pump. The timing marks on the flywheel are matched to this system.



1.	Number 1 Cylinder Fuel Injection Line
2.	Index Mark on Starter Mounting Plate

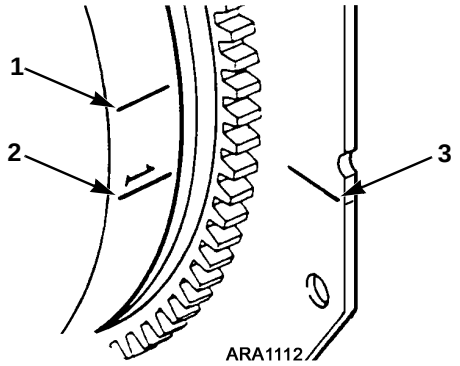
Figure 33: Component Location

CAUTION: Loosen all of the injection lines at the injection nozzles to prevent the possibility of the engine firing while it is being rotated.

1. Remove the injection line for the number 1 cylinder from the delivery valve holder on the injection pump and from the injection nozzle.

   NOTE: The number 1 cylinder is the cylinder at the flywheel end of the engine.

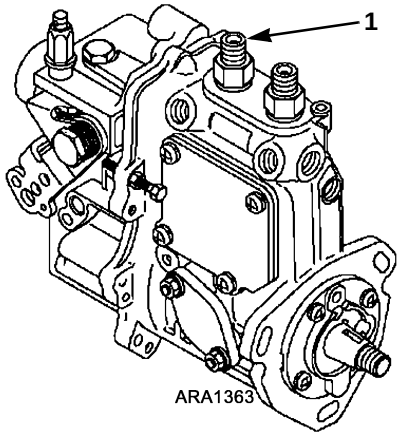
2. Remove the delivery valve spring for the number 1 cylinder by removing the delivery valve holder and the delivery valve spring, and then reinstalling the delivery valve holder without the delivery valve spring in place.
3. Remove the cylinder head cover.
4. Place the engine at top dead center of the compression stroke for the number 1 cylinder. Refer to steps a through d.
    a. Rotate the engine in the normal direction of rotation (clockwise viewed from the water pump end) until the until the top dead center mark for the number 1 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.



1.	Injection Timing Mark
2.	Top Dead Center Mark for Number 1 Cylinder
3.	Index Timing Mark on Starter Mounting Plate

Figure 34: Timing Marks

    b. Check the rocker arms on the number 1 cylinder to see if they are loose.
    c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number 1 cylinder.
    d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 1 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 1 cylinder.
5. Remove the Starter Fuse (F1) from the interface board to prevent the engine from cranking when the unit is turned On.
6. Energize the fuel solenoid and the fuel pump by turning the unit On and set the TriPac HMI to a setting that will cause the TriPac engine to attempt to start. For example, select a temperature (such as 50 F) that will cause the HMI to enter an air conditioning cycle and signal an engine start.
7. Rotate the engine backwards (counterclockwise viewed from the water pump end) until the injection timing mark (or the 16 degree BTDC mark see Figure 37) is positioned about 1.0 in. (25 mm) below the index timing mark on the starter mounting plate.
8. Use a clean towel to remove the fuel from the top end of the delivery valve holder.

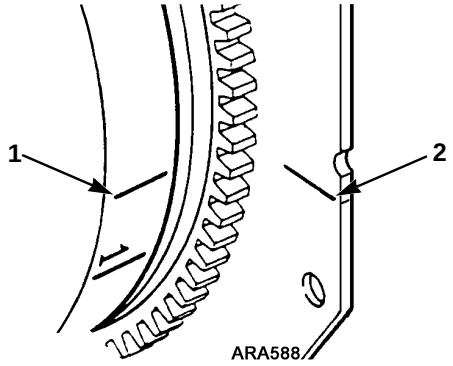


1.	Delivery Valve Holder

Figure 35: Injection Pump

9. Slowly turn the engine in the normal direction of rotation until you see the fuel rise in the end of the delivery valve holder. Stop as soon as you see the fuel rise.

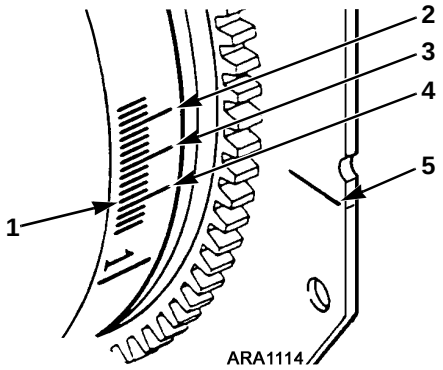
10. Check position of the timing marks. The injection timing mark on the flywheel should be aligned with the index timing mark on the starter mounting plate. Repeat steps 7 through 10 to recheck the timing.



1.	Injection Timing Mark
2.	Index Timing Mark on Starter Mounting Plate

Figure 36: Correct Injection Timing Mark Alignment

NOTE: Some engines have a series of injection timing marks as shown below. The 16 degrees BTDC (before top dead center) mark is the mark that should be aligned with the index timing mark on the starter mounting plate.



1.	16 Degrees BTDC Mark (Correct Timing Mark)
2.	25 Degrees BTDC Mark
3.	20 Degrees BTDC Mark
4.	15 Degrees BTDC Mark
2.	Index Timing Mark on Starter Mounting Plate

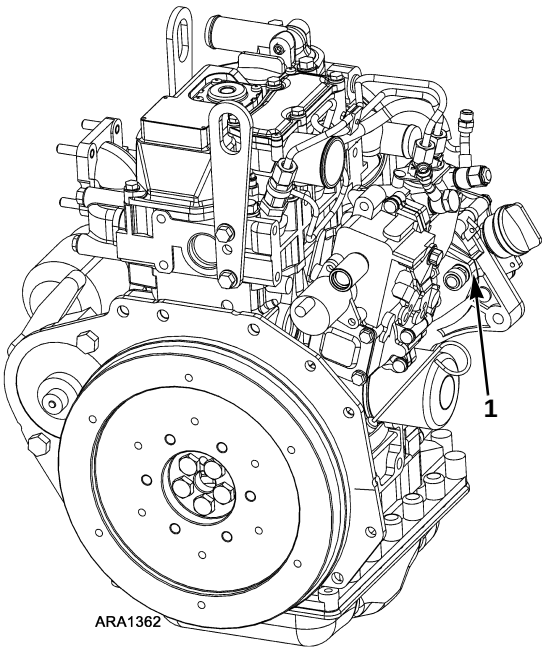
Figure 37: Correct Injection Timing Mark Alignment With Series Of Injection Timing Marks

1. If the timing is off by more than 1 degree (0.1 in. [2.5 mm]), loosen the mounting nuts on the studs that fasten the injection pump to the engine and rotate the injection pump to change the timing.
   a. Pull the top of the injection pump away from the engine to advance the timing.
   b. Push the top of the injection pump toward the engine to retard the timing.
2. Tighten the injection pump mounting nuts and recheck the timing. Repeat steps 7 through 2 until the timing is correct.
3. Install the delivery valve spring for the number one cylinder by removing the delivery valve holder, installing the delivery valve spring, and then reinstalling the delivery valve holder.
4. Install the injection line for the number one cylinder, the cylinder head cover, tighten the other injection lines, and replace the Starter Fuse (F1) in the interface board when finished with the procedure.

Injection Pump Removal and Installation

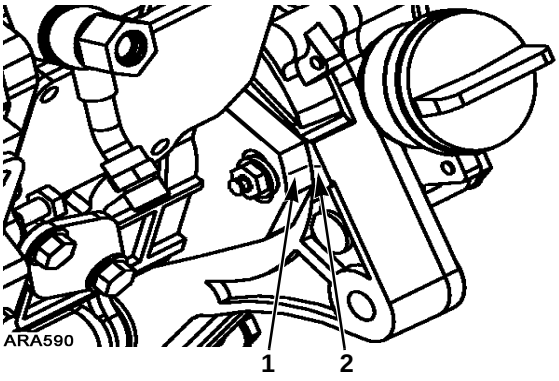
Injection Pump Removal

1. Note the alignment of the index marks on the injection pump and the gear case. If they are not marked, mark them so the injection pump can be returned to the same position when it is reinstalled.



1.	Index Marks

Figure 38: Index Mark Location



1.	Index Mark on Injection Pump
2.	Index Mark on Gear Case

Figure 39: Index Mark Alignment

2. Remove the fuel lines, wire harness, and mounting hardware from the injection pump.
3. Remove the injection pump timing cover from the gear case.
4. Loosen the injection pump gear mounting nut, but do not remove it yet.

   NOTE: The injection pump gear assembly is made of two pieces, the flange and the gear. Do not loosen or remove the four bolts that fasten the gear to the flange because that changes the timing.

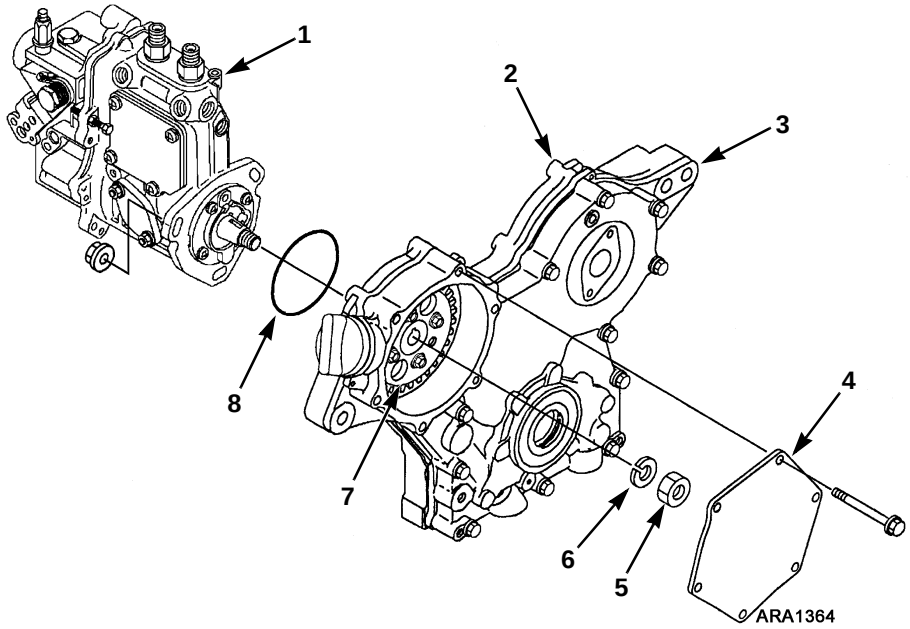
5. Use a suitable puller to loosen the injection pump gear from the injection pump shaft.
6. Remove the injection pump gear mounting nut and lock washer. Use a shop rag to prevent the lock washer or nut from falling into the gear case.
7. Remove the injection pump from the gear case, but leave the injection pump gear in the gear case. This keeps the teeth on the injection pump gear aligned properly with the teeth on the idler gear. If you remove the injection pump gear from the gear case you will have to remove the gear case cover to realign the timing marks on the injection pump gear and the idler gear.

Injection Pump Installation

1. Place a new O-ring on the injection pump and lubricate it with engine oil.
2. Place the injection pump in the gear case. Rotate the injection pump shaft to mate the key in the shaft with the keyway in the injection pump gear. Take care to make sure the key mates with the keyway.
3. Secure the injection pump to gear case with previously removed hardware. Make sure to align the index marks on the injection pump and the gear case like they were in step 1 of “Injection Pump Removal”.

   NOTE: If a different injection pump is being installed, see “Injection Pump Timing” on page 56 to set the timing.

4. Secure the injection pump gear to the injection pump shaft with the lock washer and mounting nut. Use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 43.5 to 50.9 ft-lb (59.0 to 69.0 N•m).
5. Install the injection pump timing cover on the gear case cover, and reinstall all components removed previously to facilitate the injection pump removal.



1.	Injection Pump	5.	Injection Pump Gear Mounting Nut
2.	Gear Case	6.	Lock Washer
3.	Gear Case Cover	7.	Injection Pump Gear
4.	Injection Pump Timing Cover	8.	O-Ring

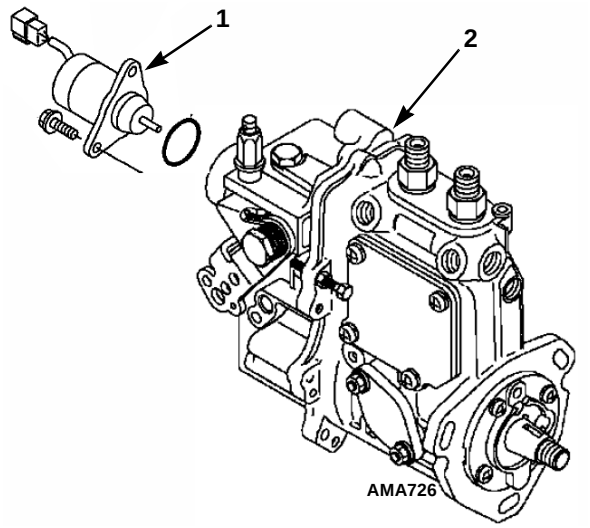
Figure 40: Injection Pump Removal and Installation

Integral Fuel Solenoid

The fuel stop solenoid is located on the end of the fuel injection pump.

Operation of the TK270 engine is controlled by the operation of the fuel solenoid. The fuel solenoid consists of a spring loaded plunger and electro-magnetic coil. When the engine is OFF, spring tension on the plunger maintains the plunger's "out" position. When pushed out, this causes the governor linkage to move the injection pump rack to the "Fuel Off" position.

When the fuel solenoid is energized, current is applied to the coil creating an electro-magnetic field,. When in the "pulled-in" position, the plunger releases tension on the governor linkage. The governor linkage then moves the fuel injector rack, thus controlling the fuel flow and placing it in the "Fuel On" position.



1.	Fuel Solenoid
2.	Fuel Injection Pump

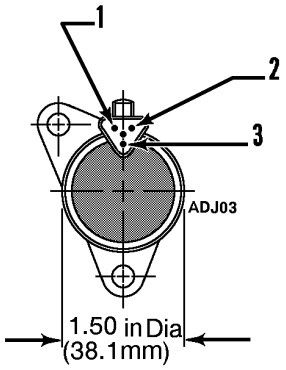
Figure 41: Integral Fuel Solenoid Components

Troubleshooting the Integral Fuel Solenoid System

NOTE: The fuel solenoid pull-in coil will require 35 to 45 amps to turn on the fuel. The unit's battery must be in good condition. If the battery has enough power to crank the engine over, it has enough power to energize the fuel solenoid pull-in coil.

If you suspect that the engine does not run because the fuel solenoid is not operating correctly, use the following procedure:

1. Disconnect the 20 wire from the reset switch so the reset switch will not trip.
2. Remove the Starter Fuse (F1) from the interface board.
3. Disconnect the fuel solenoid wire connector from the fuel solenoid.
4. Turn the unit On and check the voltage on the 8D pin in the fuel solenoid wire connector from the main wire harness when the run relay energizes during the start sequence. Refer to the following illustration to identify the pins in the wire connector and in the fuel solenoid.



1.	Pull-In Coil 8DP Color: White
2.	Hold-In Coil 8D Color: Red
3.	Common Ground Color: Black CH

Figure 42: Fuel Solenoid Pin Identification

   a. If battery voltage is not present on the 8D circuit, check the 8D circuit for an open or a short.

   b. If battery voltage is present on the 8D circuit, go to step 5.

5. Check the CH pin in the fuel solenoid wire connector for continuity to a good chassis ground.

   a. If there is no continuity between the CH pin in the fuel solenoid wire connector and a good chassis ground, check the black (CH) wire that goes from the fuel solenoid connector to the CH terminal on the throttle solenoid for an open circuit.

b. If this black (CH) wire is not open, check the other CH wire connected to the CH terminal on the throttle solenoid for an open circuit.

c. If there is continuity between the CH pin in the fuel solenoid connector and a good chassis ground, go to step 6.

6. Place a jumper wire between the CH pin in the fuel solenoid and a good chassis ground.

7. Test the pull-in coil by momentarily placing a jumper between the 8DP pin in the fuel solenoid and the positive battery terminal. The fuel solenoid should make a definite click when the pull-in coil is energized and should click again when the pull-in coil is de-energized.

   NOTE: The pull-in coil will draw 30 to 40 amps so do not leave the jumper connected to the 8DP pin for more than a few seconds.

   a. If the pull-in coil does not energize, check the resistance of the pull-in coil by placing an ohmmeter between the 8DP pin and the CH pin in the fuel solenoid. The resistance of the pull-in coil should be 0.2 to 0.3 ohms. If the resistance of the pull-in coil is not within this range, replace the fuel solenoid.

   b. If the pull-in coil does energize, go to step 8.

8. Test the hold-in coil.

   a. Energize the hold-in coil by placing a jumper between the 8D pin in the fuel solenoid and the positive battery terminal.

   b. Momentarily energize the pull-in coil by placing a jumper between the 8DP pin in the fuel solenoid and the positive battery terminal. The fuel solenoid should make a definite click when the pull-in coil is energized, but should not click when the pull-in coil is de-energized.

   c. De-energize the hold-in coil by removing the jumper from the 8D terminal. The fuel solenoid should make a definite click when the hold-in coil is de-energized.

   d. If the hold-in coil does not function properly, check the resistance of the hold-in coil by placing an ohmmeter between the 8D pin and the CH pin in the fuel solenoid. The resistance of the hold-in coil should be approximately 24 to 29 ohms. If the resistance of the hold-in coil is not in this range, replace the fuel solenoid.

   e. If the hold-in coil does function properly, go to step 9.

9. Reconnect the fuel solenoid wire connector to the fuel solenoid.

10. Remove the run relay from its socket and make sure the unit is turned ON.

11. Check the voltage on the 8D circuit at the 85 terminal in the run relay socket.

    a. If battery voltage is not present on the 8D circuit, check the 8D circuit for an open or a short (minimum voltage is 10 volts).

    b. If battery voltage is present on the 8D circuit, go to step 12.

12. Check the voltage on the 2A circuit at the 30 terminal in the run relay socket.

    a. If battery voltage is not present on the 2A circuit, check the 2A circuit for an open or a short.

    b. If battery voltage is present on the 2A circuit, go to step 13.

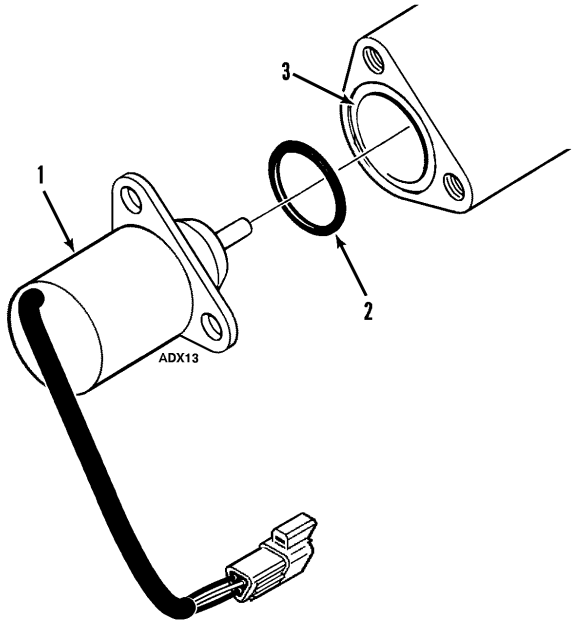
13. Reconnect the 20 wire to the reset switch.

14. Replace the Starter Fuse (F1) in the interface board.

Fuel Solenoid Replacement

1. Disconnect the 20 wire from the reset switch to prevent the reset switch from tripping.
2. Remove the Starter Fuse (F1) from the interface board.
3. Disconnect the fuel solenoid wire connector and remove the old fuel solenoid.
4. Connect the fuel solenoid wire connector to the new fuel solenoid.
5. Energize the fuel solenoid by turning the unit On and set the TriPac HMI to a setting that will cause the TriPac engine to attempt to start.

   NOTE: The fuel solenoid must be energized when it is being installed. If it is not, the plunger and the linkage may not line up correctly and the fuel solenoid will not function properly.
6. Place the O-ring in the groove in the end of the fuel injection pump. Make sure that the O-ring is positioned correctly during installation to avoid damage and leaks.
7. Install the new fuel solenoid.
8. Turn the unit off.
9. Reconnect the 20 wire to the reset switch.
10. Replace the Starter Fuse (F1) in the interface board.



1.	Fuel Stop Solenoid
2.	O-Ring
3.	Fuel Injection Pump Groove

Figure 43: Fuel Solenoid Components

Valve Clearance Adjustment

The valve clearance should be checked after every 2000 operating hours, maximum. It is important that valves be adjusted to the correct specifications for satisfactory engine operation. Insufficient valve clearance will result in compression loss and misfiring of cylinders resulting in burned valves and seats. Excessive valve clearance will result in noisy valve operation and abnormal wear of the valves and rocker arms. The intake and exhaust valves are adjusted with the valve in the closed position.

NOTE: The cylinders these engines are numbered from the flywheel end to the water pump end. The number 1 cylinder is next to the flywheel. The number 2 cylinder is next to the water pump. The timing marks on the flywheel are also numbered this way.

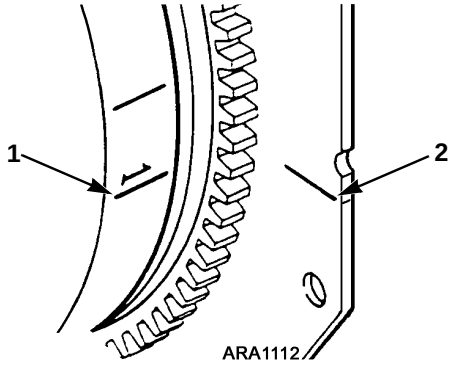
The timing marks on the flywheel of the two cylinder engines are stamped 180 degrees apart. The top dead center marks have the cylinder number stamped next to them. The injection timing marks have no identification marks (see Figure 44).

The index timing mark is stamped on the side of the starter mounting plate that faces the flywheel. This index timing mark is on the intake side of the engine.

1. Remove the cylinder head cover.

CAUTION: Loosen all of the injection lines at the injection nozzles to prevent the possibility of the engine firing while it is being rotated.

2. Place the engine at top dead center of the compression stroke for the number 1 cylinder.
   a. Rotate the engine in the normal direction of rotation (counterclockwise viewed from the flywheel end) until the top dead center timing mark for the number 1 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.
   b. Check the rocker arms on the number 1 cylinder to see if they are loose.
   c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number 1 cylinder.
   d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 1 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 1 cylinder.



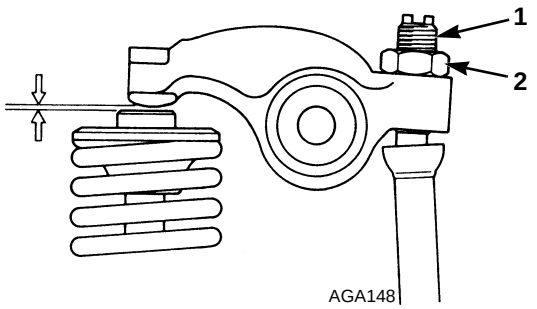
1.	Top Dead Center Mark for Number 1 Cylinder
2.	Index Timing Mark on Starter Mounting Plate

Figure 44: Timing Marks

3. Use a feeler gauge to check the valve clearance on both valves for the number 1 cylinder. The valve clearance for both the intake valves and the exhaust valves should be 0.006 to 0.010 in. (0.15 to 0.25 mm).

   NOTE: Check to make sure that the valve stem cap is in good condition and is positioned squarely on the top of the valve stem. Replace the valve stem cap if it shows significant wear.

4. Adjust the valves if necessary by loosening the lock nut and turning the adjustment screw until the valve clearance is correct.



1.	Adjustment Screw
2.	Lock Nut

Figure 45: Valve Clearance

5. Hold the adjustment screw in place and tighten the lock nut.

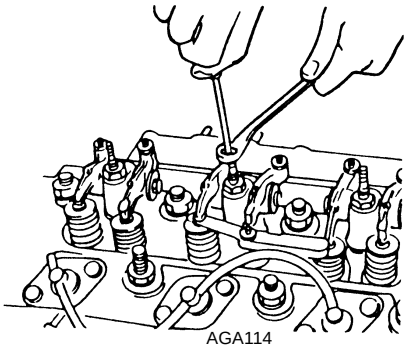


Figure 46: Adjusting Valves

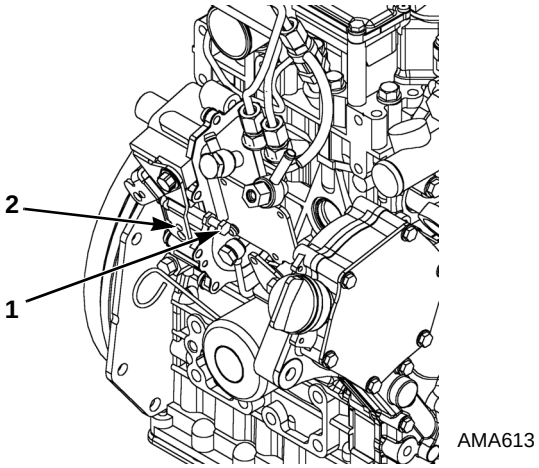
6. Recheck the valve clearance.
7. Place the engine at top dead center of the compression stroke for the number 2 cylinder.
   a. Rotate the engine in the normal direction of rotation (counterclockwise viewed from the flywheel end) until the top dead center timing mark for the number 2 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.
   b. Check the rocker arms on the number 2 cylinder to see if they are loose.
   c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number 2 cylinder.
   d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 2 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 2 cylinder.
8. Check and adjust both valves for the number 2 cylinder.
9. Replace the cylinder head cover.

Engine Speed Adjustment

(Compressor Clutch must be engaged)

1. Start the unit and let it run until the engine is warmed up. Use the HMI Controller to cause the engine to run if necessary.
2. The engine speed should be 1800 ± 25 RPM while the compressor clutch is engaged.
3. Engine speed is controlled by the governor lever. If the engine speed is not correct, loosen the jam nut on the low speed limiting bolt.
4. Turn the low speed limiting bolt to change the engine speed. Turn the screw in to increase the engine speed. Turn the screw out to decrease the engine speed.
5. Set the engine speed at 1800 ± 25 RPM and tighten the jam nut.

   (Under no-load operation, the engine speed will be approximately 1850 ± 25 RPM).



1.	Low Idling Speed Limiting Bolt
2.	Governor Lever

Figure 47: Engine Speed Adjustment

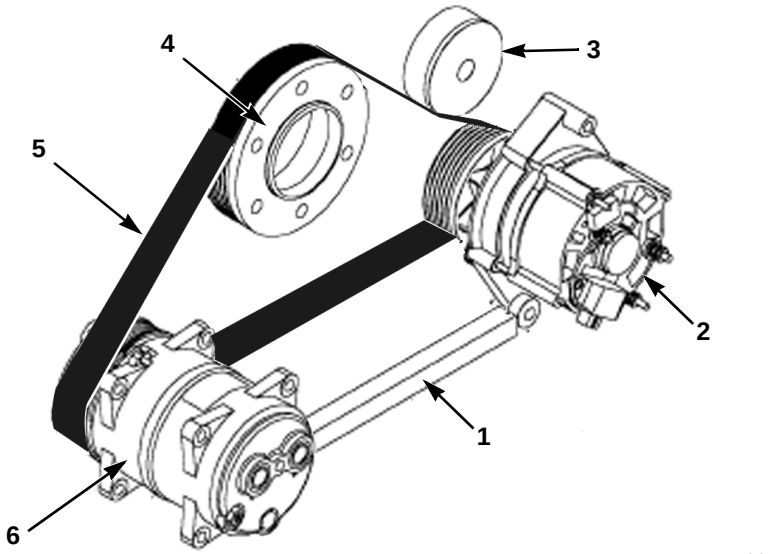
Belt Adjustment

CAUTION: The unit may start automatically and at any time when the unit switches are On. Be sure to turn switches Off before inspecting or working on any part of the unit.

Engine/Compressor/Alternator Belt Tension/Adjustment

1. The belt adjustment turnbuckle is used to adjust belt tension.
2. Rotate the turnbuckle to adjust belt tension.
   a. Adjust the belt tension to 95 pounds of force.
   b. Check belt tension after 36 to 48 hours of initial operation. The belt may stretch slightly during the first hours of use.
   c. Do not overtighten the belt. Proper belt tension should allow the belt to be deflected 0.25 in. (7 mm) at center of span with no compressor movement.

NOTE: A belt that is too tight causes severe overload on the compressor and motor bearings. This will shorten belt and bearing life. Use only approved Thermo King Service Parts replacement belts.



1.	Turnbuckle	4.	Flywheel Pulley
2.	Alternator	5.	Belt
3.	Idler Pulley	6.	Compressor

Figure 48: Belt and Pulley Group

Air Conditioning Maintenance

Maintenance Inspection Schedule

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
	•	•	Check refrigerant level.
	•	•	Check refrigerant lines for rubbing or damage.

Safety

WARNING: Make sure the TriPac can not start while servicing the system. Turn the APU Engine On/Off switch to Off.

Many service procedures are regulated by federal, state, and local laws. EPA certified technicians must perform regulated refrigeration service procedures using approved equipment and complying with all federal, state, and local laws.

Refrigerant Service Safety Procedures

Observe these precautions while performing refrigerant procedures:

- Use the recommended procedures found in this manual when servicing equipment.
- Do not apply open flame or heat the tank above 125 F (52 C). If needed to charge the A/C system, immerse the tank in 70 F to 80 F (21 to 27 C) water.
- Do not fill refrigerant tanks completely. Allow space for liquid expansion. To monitor the amount of liquid in a tank, weigh the tank before and during the filling operation.
- Do not weld or steam clean near A/C lines and components. Excessive heat builds up dangerous system pressures.
- Reinstall refrigerant tank cap after each use. This provides protection to the valve and safety plug.

DANGER: Breathing refrigerant reduces the oxygen level in the blood. Inhaling high concentrations of refrigerant vapor is harmful and can cause heart irregularities, unconsciousness, or death. Intentional misuse or deliberate inhalation may cause death.

WARNING: Do not use a Halide torch to test for leaks. When refrigerants come in contact with a flame, a highly toxic gas is produced. This toxic gas is extremely dangerous and may cause death!

- Do not breathe refrigerant fumes or vapor. Conduct test procedures in areas with good ventilation.
- Avoid skin contact with refrigerants. Refrigerant contact on skin causes frostbite.
- Do not vent refrigerants to the atmosphere. Recovery of refrigerant is required by most government regulations. Refer to local laws for the proper handling of refrigerants and refrigerant oils.
- Wear the proper clothing when handling refrigerants. Wear goggles to prevent exposure from liquid refrigerant to face and eyes. Use butyl-lined gloves when handling refrigerants.

General Refrigerant Handling Procedures

- Use clean tools to prevent contamination when opening a refrigeration system or oil containers.
- Do not expose refrigerant oil to air longer than necessary. Refrigerant oil absorbs moisture when exposed to air. Use sealed containers when storing refrigerant.
- Do not pour oil into another container unless absolutely necessary. If you must use another container, make sure it is clean and dry.
- Do not mix different refrigerants. Different refrigerants and oils are incompatible.

PAG Oil Handling Procedures

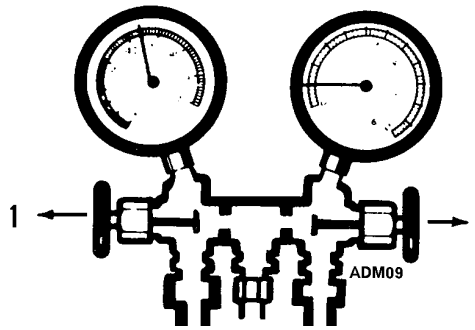
- Do not mix PAG oil with other compressor oils.
- Do not use equipment contaminated with Polyolester oils.

Gauge Manifold Connections

Use fittings designed for R-134a refrigerant.

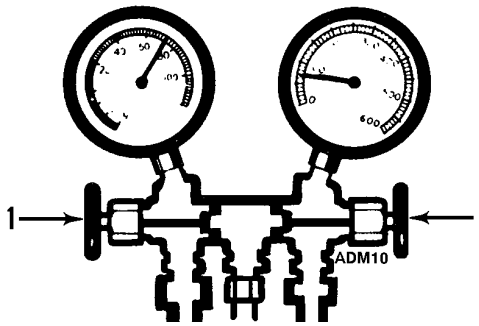
Gauge Manifold Positions

The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations.



1.	Hand Valves Opened to Center Port

Figure 49: Hand Valves Opened to Center Port

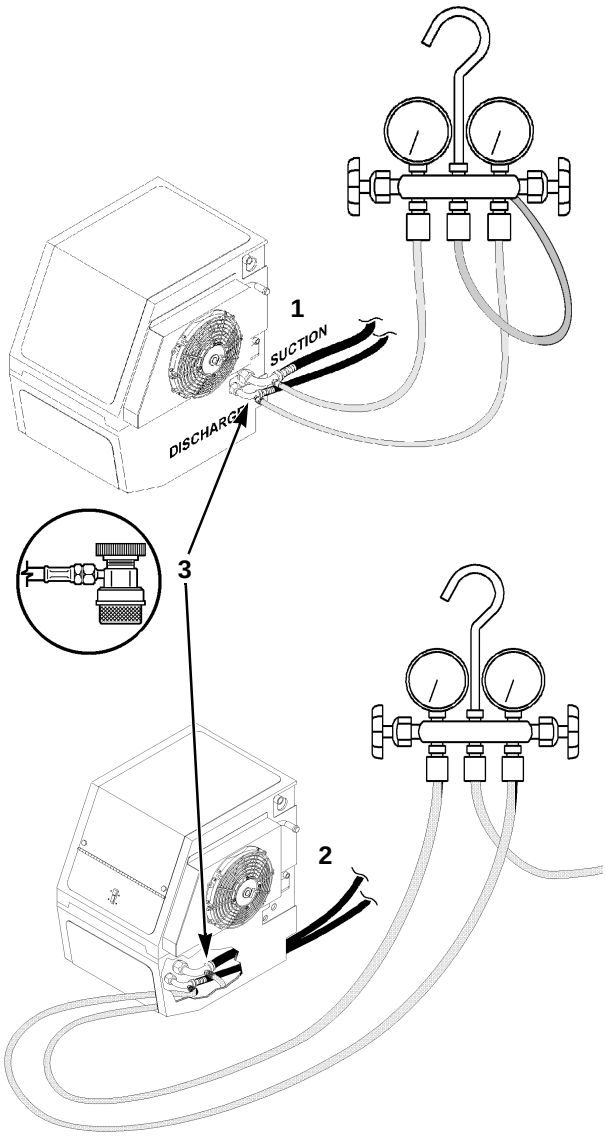


1.	Hand Valves Closed to Center Port

Figure 50: Hand Valves Closed to Center Port

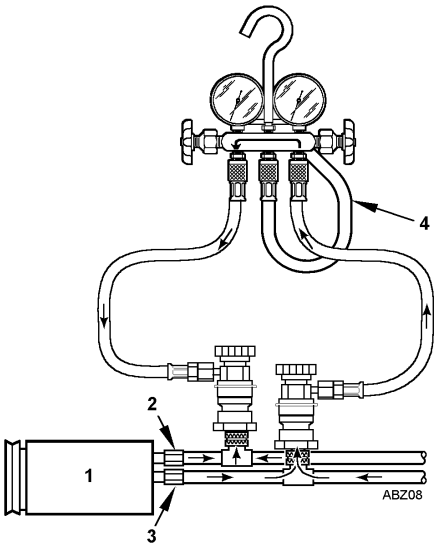
Gauge Connections

- You must leave Schrader valves in access ports, although this lengthens the time required for evacuation.



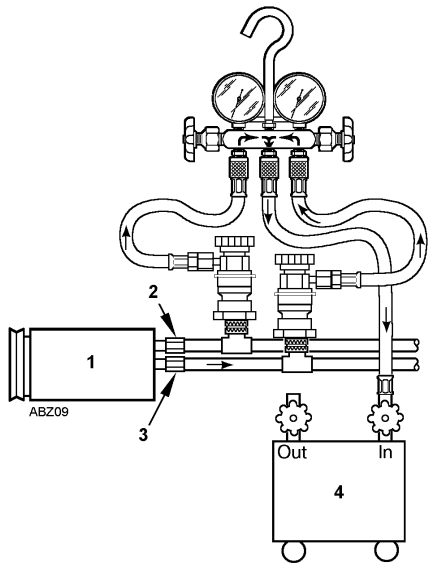
1.	Manufactured Prior to 9/06
2.	Manufactured 9/06 and later
3.	R-134a Fittings

Figure 51: Connecting the Gauge Manifold



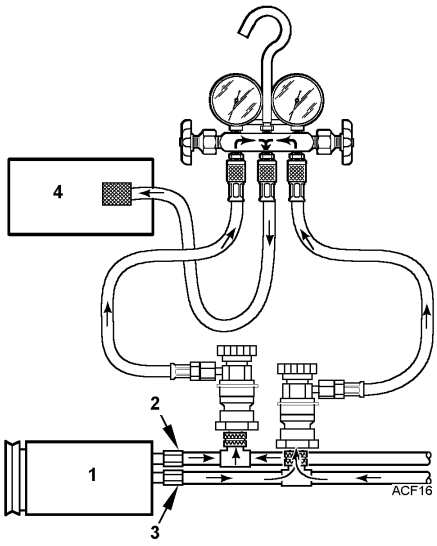
1.	Compressor
2.	Suction
3.	Discharge
4.	Hose Looped to Dead Head of Manifold

Figure 52: Balancing the Pressure



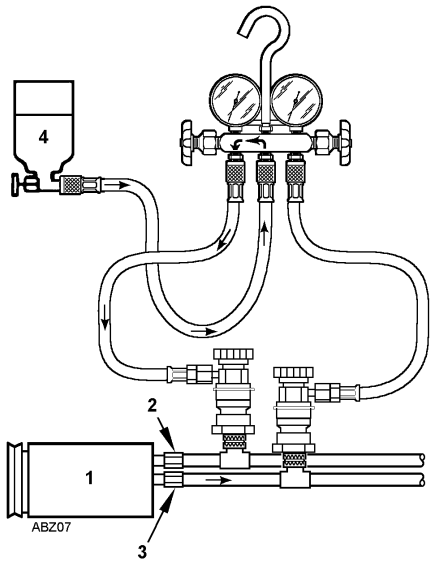
1.	Compressor
2.	Suction
3.	Discharge
4.	Recover/Recycle Machine

Figure 54: Recovering Refrigerant



1.	Compressor
2.	Suction
3.	Discharge
4.	Vacuum Pump

Figure 53: Evacuating the System



1.	Compressor
2.	Suction
3.	Discharge
4.	Refrigerant Bottle

Figure 55: Liquid Charging the System

Gauge Manifold Attachment and Purging

NOTE: This procedure describes attaching and purging for the gauge manifold set on units without compressor service valves. Inspect the gauge manifold for correct hose and fitting connections.

1. Clean dirt and moisture from around the service ports.
2. Ensure that both gauge manifold hand valves are in the closed (front-seated) position.
3. Attach the center gauge manifold hose to the "Dead Head." Tighten the fitting finger tight.
4. Remove the caps from the suction and discharge service ports.
5. Attach the high side hose (pressure gauge) to the discharge service port. Tighten the fitting finger tight.
6. Attach the low side hose (compound gauge) to the suction service port. Tighten the fitting finger tight.
7. Open the gauge manifold hand valves fully.
8. Loosen the center hose. Purge the air from discharge line. Tighten the fitting.
9. Close (front seat) the gauge manifold discharge hand valve.
10. Loosen the center hose. Purge the air from suction line through the center hose. Tighten the fitting.
11. Close (front seat) the gauge manifold suction hand valve.
12. You are now ready to use the gauge manifold to check system pressures and perform most service procedures.

Removal

NOTE: To minimize refrigerant leaks, run the system during gauge removal if possible.

1. Close (front seat) the discharge and suction manifold hand valves snugly.
2. Ensure the "Dead Head" fitting is tight.

CAUTION: Air allowed into the system will cause serious damage.

3. Quickly remove manifold set from service ports.
4. Cap the service ports with the correct sealing caps.
5. Leak test service connections and repair all leaks.

NOTE: To minimize refrigerant loss, use sealing-type quick connectors. These fittings restrict flow during evacuation.

Refrigerant Recovery

NOTE: There are many recovery machines that remove refrigerant from a system, run it through a filter cartridge once, and pump it into a refrigerant drum. This type of recovery machine will not remove the air from the refrigerant.

If the recovery machine is capable of circulating the refrigerant and actually running it through a condensing coil and has provisions for venting air from its internal system, then it does clean the refrigerant. If you are unsure of this function in your machine, read the manual.

If the machine removes only the refrigerant from the unit to a drum, then the air can still be removed by allowing the drum to sit for several hours, then venting the air from the top of the drum.

CAUTION: Venting refrigerant may be illegal in your area. Check with your local government agencies for definition of venting and your legal responsibilities.

Measure the drum temperature and pressure, then refer to a Temperature-Pressure chart to verify that there is only refrigerant in the drum. If air is

in the drum, you may wish to only draw liquid from that drum even after the air has been vented out. This precaution ensures that air is not put back into the system. Since machines are different, Thermo King recommends that the manufacturer's instructions are followed exactly.

Evacuation

Evacuation is Important and is Critical to System Performance!

It has been determined through testing and system analysis that refrigeration systems which contain non-condensables such as nitrogen and/or air can be overcharged with refrigerant when charged using the sight glass method. An overcharge of refrigerant will cause compressor damage.

Therefore, Thermo King recommends that all repairs to the refrigeration system include the removal and recycling (cleaning) of the refrigerant, followed by a thorough evacuation using the proper tools and procedures.

The primary objective of evacuation is to bring the system's pressure to a low micron level to ensure the removal of moisture and non-condensables.

Never attempt evacuation without a micron or vacuum gauge. The micron gauge will help determine:

a. If the pump is capable of pulling a deep vacuum.

b. When the vacuum pump oil is contaminated.

c. If the vacuum hoses and valves are leak free.

d. If the unit is leak free.

e. How long you should evacuate the unit.

f. That the unit is still in a deep vacuum before any lines are disconnected or refrigerant is added.

NOTE: These evacuation procedures have been written to be used with the Thermo King Evacuation System (see Tool Catalog). However, the principles of evacuation and the use of a micron gauge during evacuation should always be practiced.

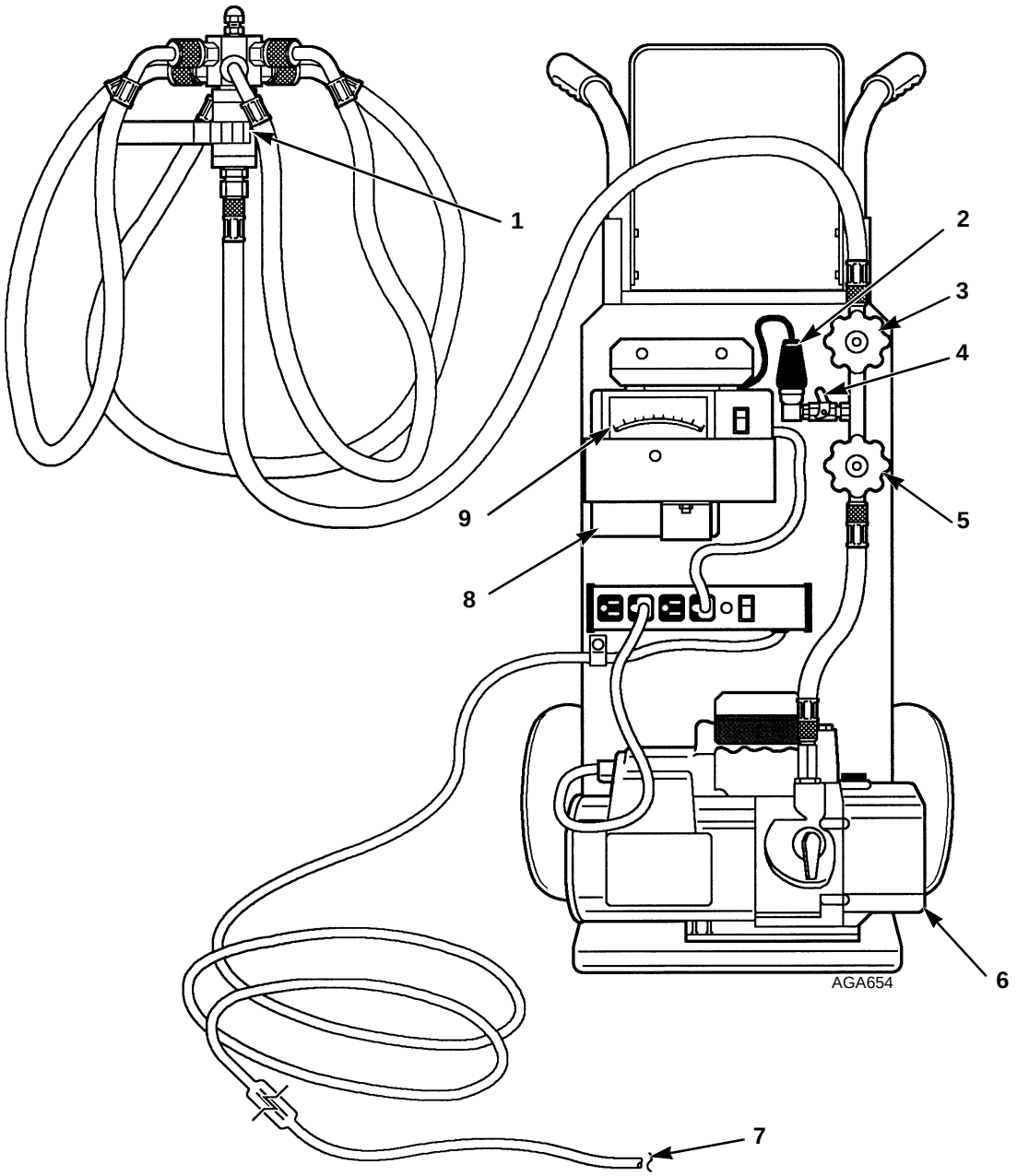
See the diagram of the Thermo King Evacuation Station and note the location of the valves.

Valve #1 (V-1): Is in the open position when the pump is running to evacuate the hoses and/or the unit. When V-1 is closed, the pump has been isolated from the hoses and/or the unit.

Valve #2 (V-2): Is in the open position during unit evacuation. In the closed position, V-2 isolates the micron gauge and thermistor assembly from the hoses and/or the unit.

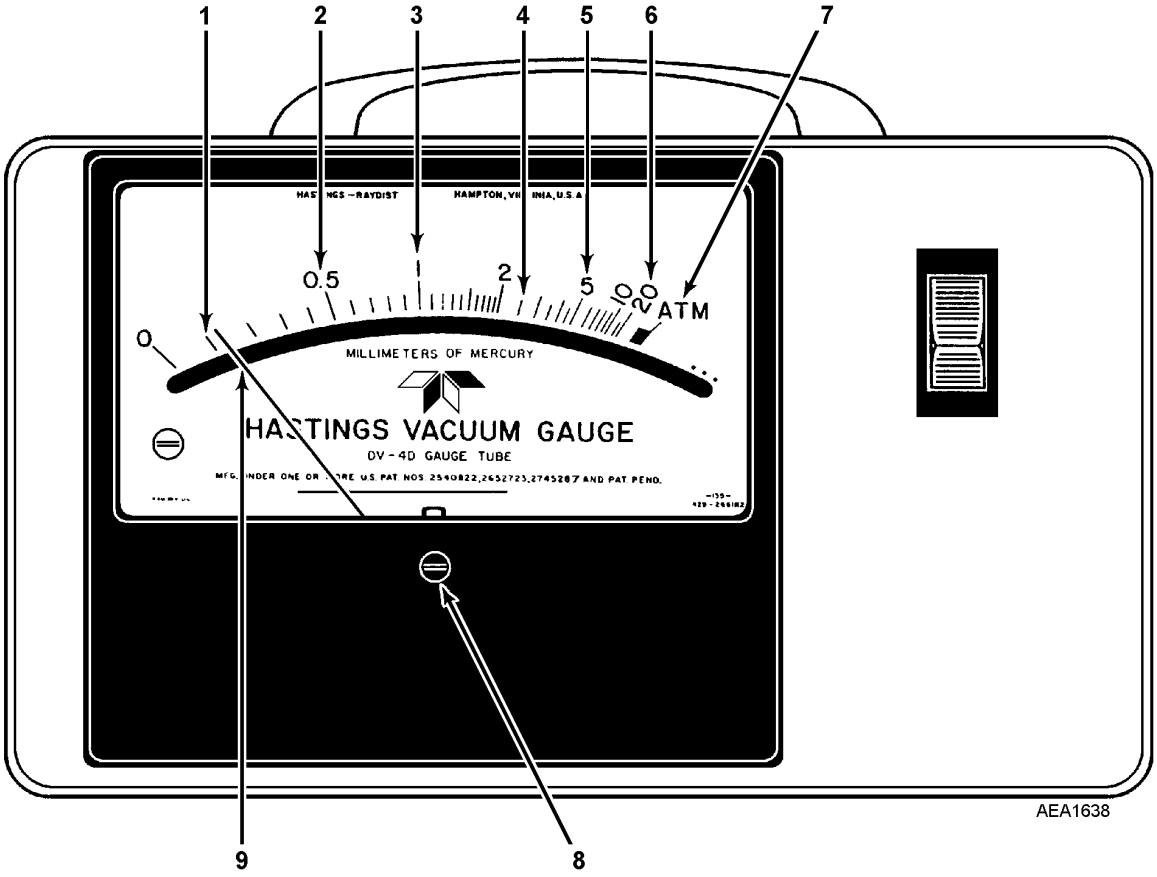
Valve #3 (V-3): Is in the open position during unit evacuation. When closed, V-3 isolates the micron gauge and the vacuum pump from the other evacuation hoses.

Valve #4 (V-4): Is in the open position during unit evacuation. When closed, V-4 isolates the evacuation hoses and the unit from the evacuation system.



1.	V-4	6.	Two Stage Vacuum Pump
2.	Thermistor	7.	To 110 Vac Power
3.	V-3	8.	Calibration Standard
4.	V-2	9.	Vacuum or Micron Gauge
5.	V-1		

Figure 56: Evacuation Station



1.	100 Microns
2.	500 Microns
3.	1000 Microns
4.	2500 Microns
5.	5000 Microns
6.	20,000 Microns
7.	Atmospheric Pressure
8.	Calibration Adjustment Screw
9.	Example: Meter needle shown at calibration position when Calibration Standard specifies 0.15 mm Hg.

Figure 57: Vacuum Gauge

Test of Evacuation Equipment

NOTE: Refer to the illustrations on the two preceding pages while reading the following instructions.

1. Connect the evacuation system to a 110 Vac power supply. Connect a gauge manifold and refrigerant supply to the fitting above valve V-4. Turn the micron gauge On.
2. Close valves V-1, V-3 and V-4. Valve V-2 is open.
3. Turn the vacuum pump On.
4. Open valve V-1 at the pump. The micron gauge needle will move to the left. (See micron gauge scale diagram—previous page).

   NOTE: If the vacuum pump is okay, and there are no leaks between V-1 and V-3, the micron gauge should show less than 500 microns. If not, locate and correct the problem.

5. With the pump still operating, open valve V-3. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.
6. With the vacuum pump still operating, open valve V-4. The micron level will rise momentarily. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.

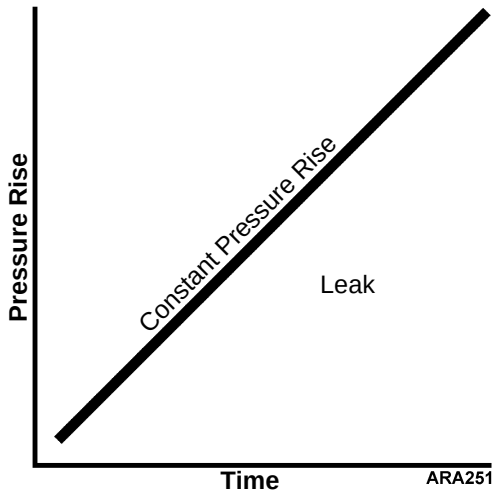


Figure 58: Leak

- Isolate the pump from the system by closing the proper valve. Watch the movement of the vacuum gauge needle. If the needle continues to rise, this is an indication that a leak exists in the unit or the connecting line. The leak must then be located and eliminated.

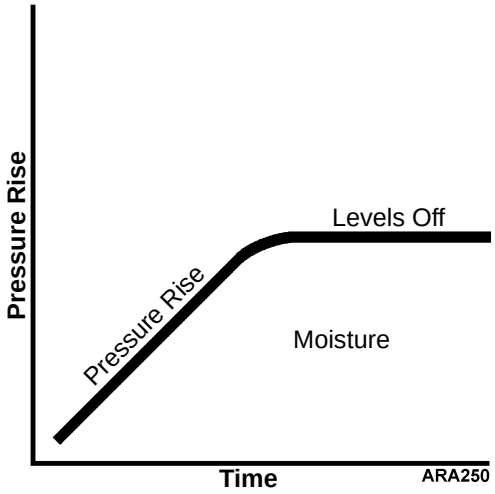


Figure 59: Moisture

- Should the needle show a pressure rise but finally level off to practically a constant mark, this is an indication that the system is vacuum tight but is still too wet, requiring additional dehydration and pumping time.

7. Evacuate hoses to 100 microns or lowest achievable level below 500 microns.
8. Once 100 microns is reached, close valve V-1 at the pump. Turn the vacuum pump Off.
9. Observe the micron gauge reading. The vacuum rise should not exceed 1500 microns in 5 minutes.
10. If the rise is above 1500 microns in 5 minutes, check all hoses and connections for leaks. Hoses with moisture present will require additional evacuation time to achieve satisfactory results.

    NOTE: Dirty vacuum pump oil or a defective vacuum pump will prevent a low micron reading. Hoses and fittings can be isolated individually to identify leaks.

Unit Evacuation Procedure

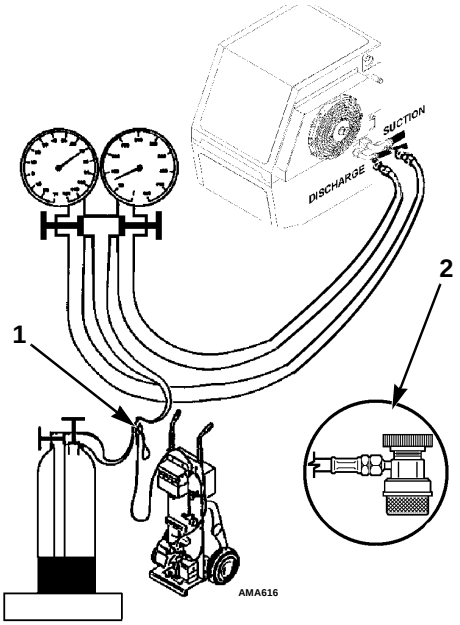
NOTE: Do not attempt to evacuate the unit until the evacuation equipment has been tested and its performance has been verified.

1. Perform all needed service or maintenance.
2. Test the system for leaks.
3. Prepare the unit for evacuation. Recover refrigerant to 0 psig (0 kPa) or EPA equivalent.

   NOTE: Federal Regulations may require your recovery machine to pull the system's pressures lower than 0 psig [0 kPa].

CAUTION: Do not attempt to evacuate a unit until you are certain that the unit is leak free. A unit with less than a full refrigerant charge should be thoroughly leak checked and all leaks must be repaired.

1. Connect one hose from the evacuation station valve manifold to a refrigerant supply bottle. Keep bottle valve closed.
2. Install gauge manifold on the suction and discharge service ports of the TriPac.
3. Connect a gauge manifold to the spare access port on valve V-4.



1.	Gauge Manifold Connection
2.	R-134a Fitting

Figure 60: Connect Gauge Manifold

4. Start the vacuum pump and open valves V-1, V-2, V-3, V-4.
5. Evacuate the system to 500 microns. After the system reaches 500 microns, evacuate for one additional hour.
6. After the additional one hour of evacuation, close valve V-1 at the pump. Turn the pump to Off.
7. Observe the reading on the micron gauge after 5 minutes have elapsed. The vacuum rise should not exceed 2000 microns. If the vacuum level exceeds 2000 microns after 5 minutes, a leak is present or additional evacuation time is required.
8. If the vacuum level is acceptable, start the pump and open valve V-1 to evacuate the pressure rise (5 minutes).
9. Close valve V-1 and stop the pump. Observe the micron gauge to confirm that the system remains in a deep vacuum. Close valve V-4. The unit is ready to charge.

Charging Procedures

CAUTION: When charging with liquid refrigerant, do not allow the suction pressure to rise by more than 20 psig (138 kPa) above running pressure. Some compressor designs are sensitive to larger quantities when charged with liquid refrigerant.

CAUTION: Different refrigerants require different types of oil to operate correctly. Do not mix these oils or the refrigerants. Consult the compressor oil chart in the front of this manual for additional information.

Charging from an Evacuated State

1. Evacuate the system using a vacuum pump and micron gauge following the procedures in this manual. (See “Unit Evacuation Procedure”).
2. Close both gauge manifold and hand valves. Verify that Valve V-4 on the Thermo King evacuation station is closed off.
3. Open the refrigerant supply bottle valve to deliver liquid refrigerant to the gauge manifold. Set scale to weigh refrigerant.
4. With the unit off, open the high side gauge valve to allow liquid refrigerant to flow into the discharge side of the unit.
5. When the required amount of refrigerant has flowed into the unit, close the high side gauge hand valve.

   If the refrigerant stopped flowing into the unit before the full refrigerant charge was reached, close the high side gauge hand valve and proceed to “Charging from a Partially Charged State,” Step 3.
6. Start the APU and allow the unit to run for 15 minutes to stabilize the system.

   NOTE: Interior temperature should be 70 to 75 F. On cool nights or mornings it may be necessary to pre-heat the sleeper compartment interior to properly check the charge.
7. Check the discharge pressure. If the discharge pressure is not above 150 psig (1034 kPa) for R-134a systems, partially block the condenser air flow to raise the pressure to that level.
8. Check the liquid line sight glass. The liquid line sight glass should be full and clear with no bubbles. If bubbles are found in the liquid line sight glass proceed to “Charging from a Partially Charged State” below.
9. After confirming the charge, close the refrigerant supply bottle valve, close all service valves, remove the manifold gauge set, and turn off the engine.
10. Replace all service caps. Leak check all areas and repair any leaks.
11. Release the TriPac back into service.

Charging from a Partially Charged State

1. Connect a gauge manifold to the system (see “Gauge Manifold Attachment, Purging, and Removal”).
2. Connect a refrigerant supply bottle to the center hose of the gauge manifold. Purge all non-condensable gases from the hoses and gauge manifold before opening the manifold’s service valves. Make sure that the refrigerant supply bottle is set to deliver only liquid refrigerant to the gauge manifold.
3. Start the unit in Air Conditioning Mode. Allow the unit to run for 15 minutes to stabilize the system.

   NOTE: Interior temperature should be 70 to 75 F. On cool nights or mornings it may be necessary to pre-heat the sleeper compartment interior to properly check the charge.
4. Check the discharge pressure. If the discharge pressure is not above 150 psig (1034 kPa) for R-134a systems, partially block the condenser air flow to raise the pressure to that level.

CAUTION: Do not turn off the condenser fan. Excessive pressures can build up and cause an explosion.

5. Crack open the low side gauge valve to allow liquid refrigerant to slowly flow into the compressor suction service valve port. (No more than 20 psi above running suction pressure.
6. Watch the liquid line sight glass. Add liquid refrigerant 1 oz. at a time until the liquid line sight glass is clear. Then close the low side gauge valve.
7. Let the system run for 15 minutes to stabilize.
8. Check the liquid line sight glass. The liquid line sight glass should be full and clear with no bubbles. If bubbles are found in the liquid line sight glass, repeat steps 6 through 8.
9. After confirming the charge, close the refrigerant supply bottle valve, close all service valves, remove the manifold gauge set, and stop the engine.
10. Replace all service caps. Leak check all areas and repair any leaks.
11. Release the TriPac back into service.

Charging Your Air Conditioning System In Cooler Weather

The cool spring and fall weather may make it harder to check and top-off the charge of the TriPac air conditioning system. More care must be taken to insure that the normal procedure is followed. Specific charging procedures are required to place the air conditioning system into an operating mode similar to that seen under normal operation.

Procedures for R-134a

Clear the liquid line sight glass and/or float the ball in the receiver tank glass when:

1. The compressor discharge pressure is above 150 psig (1034 kPa). During other operating conditions refrigerant can collect in coils or tubing and mislead the service technician. An over charge condition may result.
2. Interior temperature should be 70 to 75 F. On cool nights or mornings it may be necessary to pre-heat the sleeper compartment interior to properly check the charge.

Operating conditions other than those listed will not guarantee the proper refrigerant charge for your system, and may lead to a false alarm from a diagnostic controller.

Testing System for Leaks

1. Use an electronic leak detector to leak test the refrigeration system. Carefully inspect the entire system for refrigerant oil leaks (which indicate refrigerant leaks), component damage, and the audible release of refrigerant.

DANGER: Due to environmental concerns and personal safety, do not use a Halide torch. Using this torch creates a poisonous gas which may cause death.

NOTE: The leak tester must be capable of detecting fluorine-based refrigerants.

NOTE: To perform a proper leak check, the air conditioning system should be charged with sufficient refrigerant to have a gauge pressure of at least 50 psi (340 kPa) when not in operation. At temperatures below 59 F (15 C), leaks may not be measurable because this pressure may not be reached.

2. Install a gauge manifold set.
3. Check low side pressure gauge reading. The manifold gauge will have a reading that falls into one of three ranges:

0 PSI Reading

There is no pressure in the system with no obvious signs of a major leak. Pressurize the system to 25 psi with refrigerant. Monitor system pressure for one minute.

- Pressure reading does not change or falls slowly. The leak is small. You may add more refrigerant to this system and know that it will not rapidly vent to the atmosphere. Proceed to the 1 to 50 psi procedure.
- Pressure drops rapidly. The leak is large. Further inspection is required. Do not add more refrigerant to the system because it will vent to the atmosphere.

1 to 50 PSI Reading

Since the system is holding some pressure, you can add refrigerant to the system without it being vented to the atmosphere.

1. Add refrigerant to the system to increase pressure.
2. Add enough refrigerant to raise system pressure up to bottle pressure. Keep track of how much refrigerant you add.

   NOTE: This refrigerant will be recovered when the leak check is complete. You may use refrigerant from a recovery tank to raise pressure.
3. Perform a complete and thorough leak check.
4. Recover refrigerant from the system.

Over 50 PSI Reading

The low side reading must show at least 50 psig of pressure.

1. Using the existing system pressure, perform a complete and thorough leak check.
2. If no leaks are found, but the system has lost some of its refrigerant pressure, proceed to the 1 to 50 psi procedure.

This leak check procedure gives the technician a good opportunity to locate a refrigerant leak. Because nothing is lost or vented, the procedure is both economical and environmentally friendly.

Receiver-Drier Removal and Installation

NOTE: It is recommended that the receiver-drier be replaced when the system is opened.

CAUTION: Use extreme care when working near the exposed coil fins. Coil fins are very sharp and can cause painful lacerations. Use gloves when handling coil.

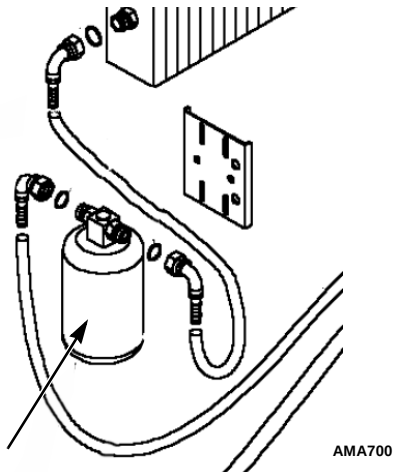


Figure 61: Receiver-Drier

Removal

1. Turn the unit off.
2. Recover all refrigerant from the system.
3. Disconnect the refrigeration and electrical connections. Cap the refrigeration connections to prevent contamination.
4. Locate the receiver-drier and loosen the mounting hardware.

   NOTE: When removing or replacing the fitting nuts on the receiver-drier, always hold the body of the receiver-drier near the fittings to prevent twisting the tubing when the nuts are being loosened or tightened.
5. Use two wrenches (tubing wrenches recommended) to disconnect the connections, and remove the receiver-drier.
6. Discard the old receiver-drier.

Installation

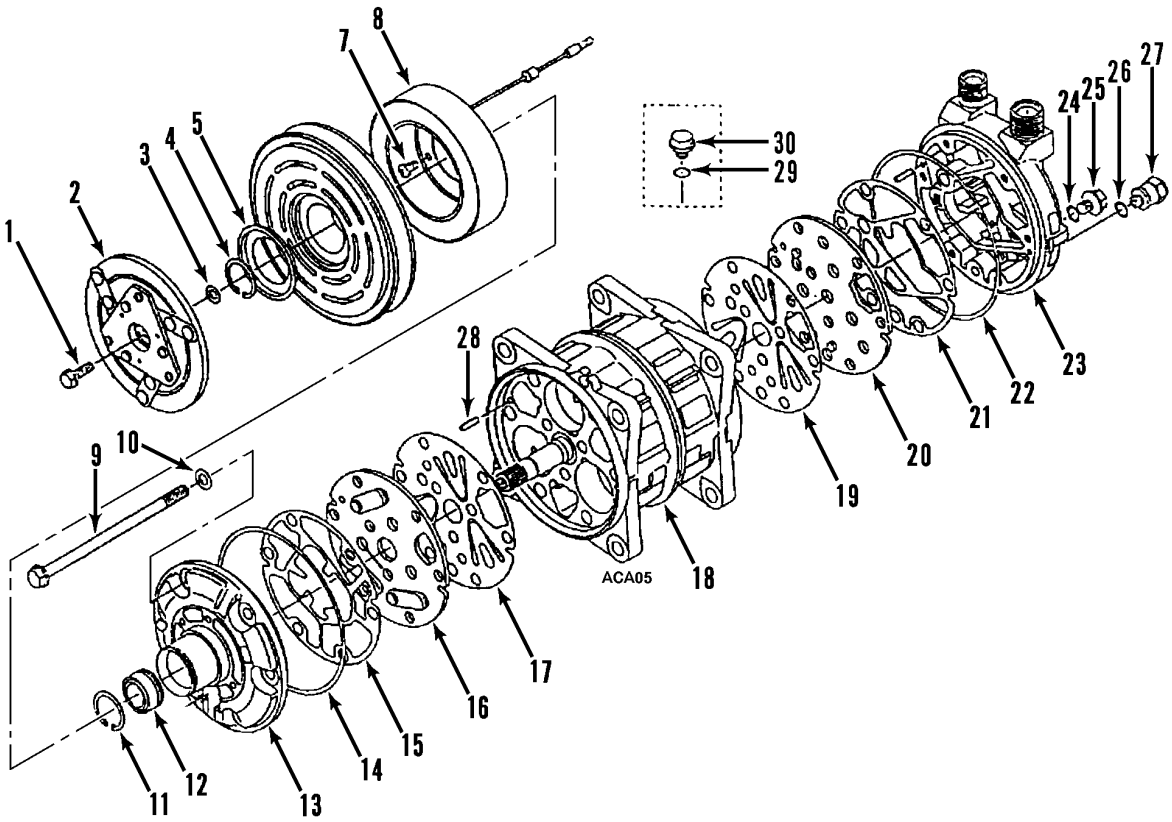
NOTE: The longer the receiver-drier remains open to the air, the more moisture it will absorb. That moisture shortens the usable life of the receiver-drier.

1. Clean all fittings. Remove the protective caps from the new receiver-drier and oil the threads with the same type of refrigerant oil that is used in the compressor. Install the new receiver-drier as quickly as possible.
2. Tighten the receiver-drier mounting hardware.
3. Replace refrigerant lines and electrical connections.
4. Evacuate the system and check for leaks. Repair as needed.
5. Recharge the system per procedures recommended in this manual.

   NOTE: Whenever a major loss of refrigerant has occurred or when a filter-drier is installed, additional oil may be required. Refer to oil charging procedures found in this manual.
6. Run the TriPac and verify proper operation.

TM-15 Compressor Maintenance

NOTE: For compressor specifications, see the Specifications chapter in this manual.



1.	Armature Bolt	16.	Front Valve Plates
2.	Armature Plate	17.	Front Suction Valve
3.	Shim	18.	Cylinder Shaft Assembly
4.	Snap Ring	19.	Rear Suction Valve
5.	Cover	20.	Rear Valve Plate
6.	Pulley Assembly	21.	Rear Gasket
7.	Coil Screw	22.	O-ring, Body
8.	Coil	23.	Rear Cylinder Head
9.	Body Bolt	24.	O-ring, Drain Plug
10.	Washer	25.	Drain Plug
11.	Snap Ring	26.	O-ring, PRV
12.	Shaft Seal	27.	PRV
13.	Front Cylinder Head	28.	Pin, Alignment
14.	O-ring, Body	29.	O-ring, Oil Fill Plug
15.	Front Gasket	30.	Oil Fill Plug

Figure 62: Compressor Components

Compressor Handling and Storage

CAUTION: Do not turn the compressor upside down. If the compressor is turned upside down, rotate the armature plate several times to circulate oil.

Store new and rebuilt compressors:

- With the correct oil charge
- Horizontally
- With a holding charge of nitrogen to a pressure of 7 to 21 psig (48 to 145 kPa). This protects internal parts from moisture and corrosion

Removing the Compressor

1. Remove the refrigerant from the unit following procedures in the Refrigeration Maintenance chapter in this manual.
2. Remove the hose connections from the compressor manifold.
3. Inspect hoses for wear, hardness, and traces of oil. Replace if necessary.
4. Remove the compressor from the mount, noting the location of all brackets and adjustment bolts.
5. Drain and measure the oil from the compressor. The correct oil amount is listed in the Specifications chapter of this manual. (Thermo King P/N 203-544)
6. Consult specifications for correct oil.

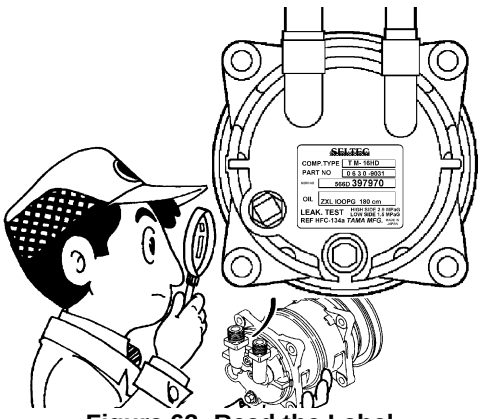


Figure 63: Read the Label

7. Inspect the oil for contamination. See "Checking Compressor Oil for Contamination" in this chapter for more information.
8. Add oil as needed to the compressor. See the Specifications chapter in this manual for oil amount. See procedure for adding compressor oil in this manual.
9. If necessary, place a new Thermo King oil label on the compressor.

Compressor Installation Procedures

Installation Precautions

Thermo King replacement compressors can be shipped with one of three oil configurations: PAG oil, POE oil, or no oil and a nitrogen holding charge. If the oil in the compressor does not match your system, it must be changed to the correct type for use in the TriPac system.

When mounting the compressor, take the following precautions:

1. Loosen the discharge side connector cap if equipped. Slowly release the holding charge.

Figure 64: Loosen Caps Slowly

CAUTION: Do not let oil escape.

2. Rotate the armature plate several times to circulate oil that has settled in the cylinders.

Figure 65: Rotate Armature Plate

3. Verify that the compressor oil type matches the system oil type. If not, drain the compressor oil and replace it with the oil type in the system.

Installing the Compressor

To install the compressor:

1. Mount the compressor
2. Secure the mounting hardware. Tighten adjustments as required for proper belt tension. (See specifications.)
3. Install new suction and discharge line O-rings. Connect the suction and discharge hoses.
4. Perform a leak test on the system using the same refrigerant used in the system. See Refrigeration Maintenance chapter in this manual for leak testing procedures.
5. Evacuate the system using the micron gauge method.
6. Charge the system with the correct refrigerant. See system charge specification.
7. When the system is charged, confirm that the system is functioning correctly by operating for several minutes.

Compressor Oil Caution Statements

CAUTION: Do not leave a system or oil containers open to the air longer than necessary. Compressor oils (POE and PAG) absorb moisture. Moisture-contaminated oil will damage system components.

CAUTION: Do not open refrigeration system unnecessarily. Doing so increases chances of contamination.

CAUTION: Discard used oil containers. These containers are hazardous.

CAUTION: Do not store PAG oil in plastic containers. PAG oil absorbs moisture through the plastic container.

Oil Charge Considerations

Most compressors come with a factory oil charge, which is listed on the label. This oil charge is not necessarily the correct amount. See the Specifications chapter in this manual for oil charge information.

CAUTION: Not using the correct oil charge will damage your system.

Oil Type Considerations

Your compressor comes with an oil charge that may not be compatible with your system. Check system decals and operation manual for correct oil type. See “Compressor Installation Procedures.”

If the oil charge in a new compressor is not compatible with your air conditioning system, remove and replace the oil.

CAUTION: Mixing incompatible oils will damage your system.

Oil Check Interval

Check compressor oil:

- Per maintenance schedule
- When the compressor, evaporator, condenser, or receiver-drier is replaced
- When refrigerant has leaked from the system (for example, high pressure relief valve discharges)
- When refrigerant leaks from the compressor

Returning Oil to Compressor, Recovering Refrigerant, and Removing Compressor

During operation, oil circulates with refrigerant in a system. Before checking the oil, you must return as much as possible to the compressor. Not doing so will result in an incorrect measurement.

To return oil to the compressor:

1. Open the cab doors and windows to raise the interior air temperature to 75 to 80 degrees (25 to 27 C). The ambient air temperature should be above 85 degrees F (29 C). If not, partially block the condenser air flow to raise the compressor discharge pressure above 170 psig (1172 kPa).)
2. Run the A/C system for approximately 20 minutes.
3. Turn the A/C system off.
4. Stop the unit and disconnect the battery for safety.
5. Recover the refrigerant. See the Refrigeration Maintenance chapter in this manual.
6. Remove the compressor from the system. See “Removing the Compressor” on page 82.
7. Drain the oil as described.

Oil Check Procedure: Draining, Measuring, and Inspecting the Oil

1. Perform the “Returning Oil to Compressor, Recovering Refrigerant, and Removing Compressor” procedure above.
2. Remove the drain plug from the compressor.
3. Drain oil from the compressor drain plug and all other ports.

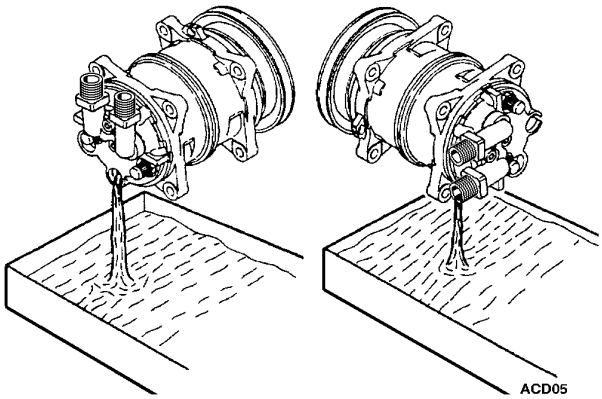
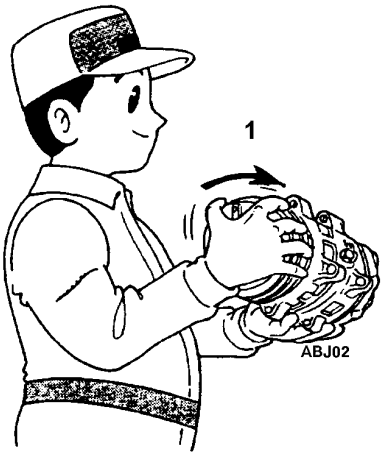


Figure 66: Draining the Oil

4. Remove remaining oil through the discharge side connector by manually rotating the armature plate until all oil is removed.



1.	Rotate Armature Plate Several Times

Figure 67: Armature Plate Rotation

5. Measure oil in a graduated cylinder or measuring cup.
    - If the oil amount is less than 3/4 of a full oil charge, replace with a full charge of new oil
    - If the oil charge is more than 3/4 of the required oil charge, replace only the amount of oil you removed

    NOTE: See the Specifications chapter in this manual for correct oil charge.
6. Inspect oil for contamination.
7. Replace the oil drain plug and tighten it per specifications (see “Torque Values” in the Specifications chapter).
8. If necessary add oil.
9. Change the receiver-drier. See the Air Conditioning Maintenance chapter in this manual for procedure.
10. Install the compressor. Tighten the mounting bolts.

Checking Compressor Oil for Contamination

Inspect extracted oil for the following:

- Dirt
- Color changed to dark brown, gray, or black
- Presence of foreign substances, metal shavings, etc. in the oil

Dark brown oil indicates high compressor temperatures. Gray oil indicates metal contamination. Black oil indicates severe contamination.

To determine the extent of contamination, remove the receiver-drier and check the oil color there. If the oil is contaminated at the receiver-drier, flush the system with industry approved materials.

If the oil is clean at the receiver-drier, install a new filter-drier and replace the oil with new oil. See “Adding Compressor Oil”.

Adding Compressor Oil

To add oil:

1. Verify the correct oil type on the compressor label.
2. Verify the correct oil amount. See the Specifications chapter in this manual or, for replaced components, use the chart shown.

Oil Amounts per Replaced Components[1]

Component Replaced	Refrigerant Charge in Pounds (kg)
	1-3 (0.5 to 1.4)
	Oil to Add in Ounces (ml)
Condenser	0.3 (9)
Evaporator	1 (29)
Receiver-Drier	0.3 (9)

[1] These amounts are approximations. Individual systems may vary.

3. Add oil to the compressor through the suction port as shown in Figure 68. Use fresh oil taken only from a sealed metal container.
4. Turn the armature plate manually several times while adding oil to distribute oil evenly.

NOTE: Replace the system receiver-drier if the system was opened for service.

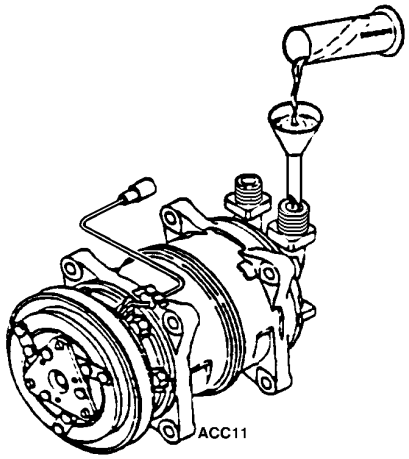


Figure 68: Small Compressor Oil Fill Procedure

Clutch Procedures

Clutch Test

1. If the field coil lead wire is broken, replace the field coil.
2. Check the amperage and voltage. The amperage range should be 3.6 to 4.2 amps at 12 volts. Note the following symptoms and conditions:
   a. A very high amperage reading indicates a short within the field coil.
   b. No amperage reading indicates an open circuit in the winding.
   c. An intermittent or poor system ground results in lower voltage at the clutch. Check for tight fit on the coil retaining snap ring or for a good ground at the coil retaining screws.
3. Air Gap—An incorrect air gap can cause erratic engagement or disengagement, and/or clutch rattle. Check the air gap with a feeler gauge. The air gap should be 0.016 to 0.031 in. (0.4 to 0.8 mm). See “Clutch Installation” for information about adjusting the air gap.

Clutch Removal, Inspection, and Installation

NOTE: Make sure the proper tools are available before performing maintenance procedures. Contact your local Thermo King dealer for further information.

Removal

1. Remove the center armature bolt. Use the pulley arbor TK No. 204-804 to prevent armature plate rotation.

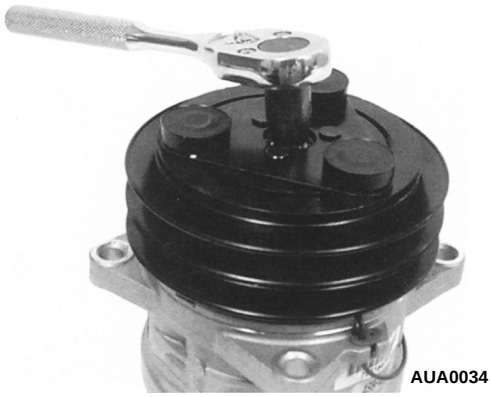
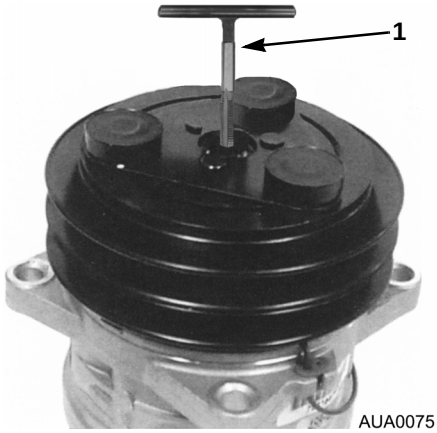


Figure 69: Remove Center Bolt

2. Remove the armature plate using the armature plate puller. Then remove the shims from either the drive shaft or the drive plate.

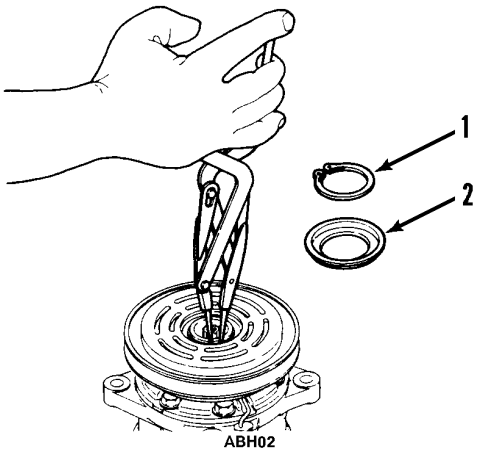


1.	Armature Plate Puller

Figure 70: Remove Armature Plate

3. Remove the snap ring using external snap ring pliers (TK No. 204-808).

4. Remove the cover (if equipped).



1.	Snap Ring
2.	Cover (If Equipped)

Figure 71: Remove Snap Ring and Cover

5. Remove the pulley assembly using the pulley remover (TK No. 204-806) and the spacer positioned on the cylinder head hub.

CAUTION: To avoid damaging the pulley groove, the pulley claws should be hooked into (NOT UNDER) the pulley groove.

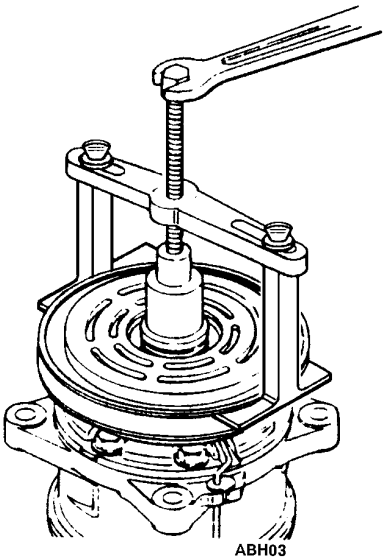


Figure 72: Remove Pulley

6. Remove the coil's lead wire from the holder on the top of the compressor.

7. Remove the three screws that attach the coil to the compressor and remove the coil.

NOTE: DO NOT hold the coil by the lead wire.

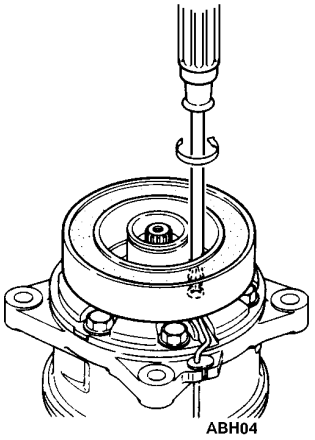


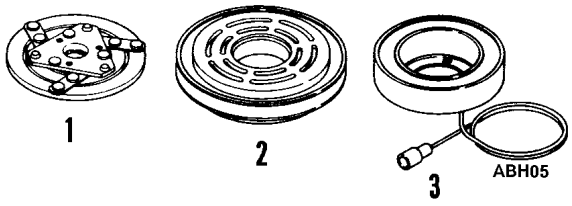
Figure 73: Remove Coil

Inspection

1. **Armature Plate:** If the contact surface is scorched, the armature plate and pulley should be replaced.

2. **Pulley Assembly:** If the pulley's contact surface is excessively grooved due to slippage, both the pulley and armature plate must be replaced. There should also be no foreign matter, such as oil or grit, lodged between the armature plate and pulley. Thoroughly clean these contact surfaces and the armature plate.

3. **Coil:** Inspect the coil for a loose connector or cracked insulation. If the insulation is cracked, replace the coil. Repair or replace the wire or the connector if either is loose or damaged.



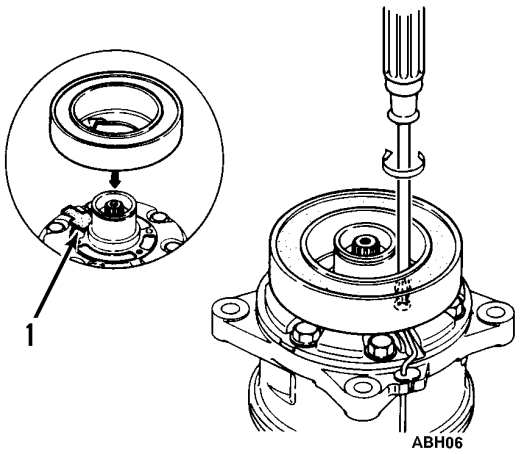
1.	Drive Plate
2.	Pulley Assemble
3.	Coil

Figure 74: Inspect Clutch Components

Installation

NOTE: Before installing the clutch, perform the "Inspection" procedures described previously.

1. Confirm that the felt is installed (if equipped) on the front of the cylinder head.
2. Install the coil on the compressor (with the lead wire on top). At this time, confirm that the coil's concave portion is aligned with the felt (if equipped) and then torque the mounting screws to 2.9 to 4.3 ft-lb (4 to 6 N•m).
3. Install the lead wire in the wire holder on the compressor.



1.	Felt (If Equipped)

Figure 75: Install Coil

4. Install the pulley assembly using the Installer (TK No. 204-890) and a hand press.

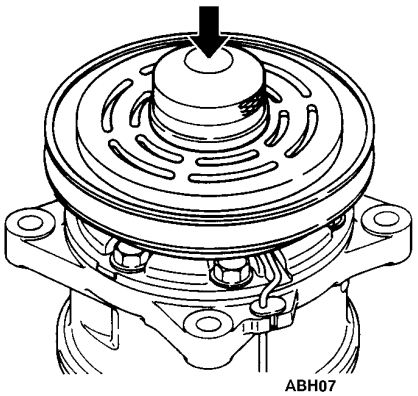
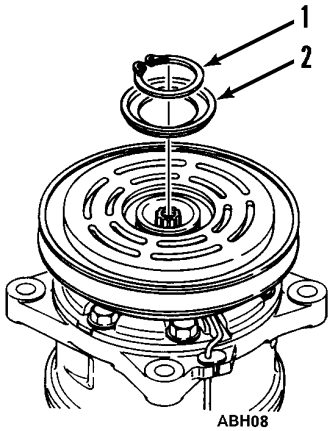


Figure 76: Install Pulley

5. Install the cover (if equipped) and the snap ring using external ring pliers.

   NOTE: The snap ring should be installed with the chamfered inner edge outward (facing away from seal).

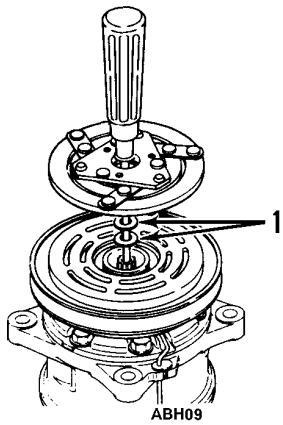


1.	Snap Ring
2.	Cover (If Equipped)

Figure 77: Install Cover and Snap Ring

6. Install the driver plate on the drive shaft, together with the original shim(s). Press the drive plate down by hand.

   NOTE: If replacement or additional shims are required, a clutch hardware kit is available (ICE No. 2530109)



1.	Shims

Figure 78: Install Shims and Drive Plate

7. Install the armature bolt and torque it to 8.7 to 10.1 ft-lb (12 to 14 N•m). Use the pulley arbor TK No. 204-804 to prevent armature plate rotation. After tightening the bolt, ensure that the pulley rotates smoothly.
8. Check the air gap with a feeler gauge. The air gap should be 0.016 to 0.031 in. (0.4 to 0.8 mm). If necessary, adjust the air gap by adding or removing shims. Adjusting shims are available in the Clutch Hardware Kit (ICE No. 2530109).

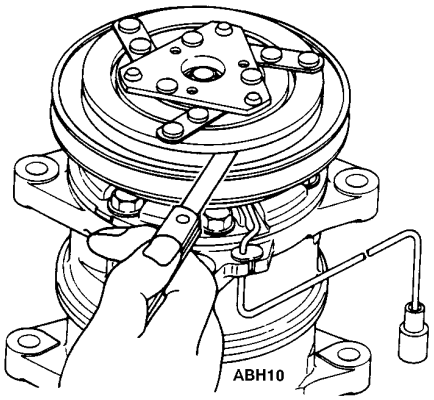


Figure 79: Check Air Gap

Electrical Connection

1. Connect the lead wire to the electrical circuit.

   NOTE: The stationary field is grounded at the factory; therefore, it is necessary only to connect the hot (lead) wire.

2. Engage and disengage the clutch several times to check the clutch engagement. The armature plate should snap firmly against the pulley.

Pulley and Belt Alignment (Engine-Driven Compressor)

The compressor clutch must be perfectly aligned with the engine pulley and any idler or pulley components.

1. Make sure the clutch is installed properly.
2. Verify pulley alignment by making sure the belt goes from pulley to pulley in perfect alignment, with no indication of a sideward bend.

Belt Tension

1. Adjust the belt tension to 95 pounds of force.
2. Check belt tension after 36 to 48 hours of initial operation. The belt may stretch slightly during the first hours of use.
3. Do not overtighten the belt. Proper belt tension should allow the belt to be deflected 0.25 in. (7 mm) at center of span with no compressor movement.

CAUTION: A belt that is too tight causes severe overload on the compressor and motor bearings. This will shorten belt and bearing life. Use only approved Thermo King Service Parts replacement belts.

Sleeper Cab Air Heater Maintenance

Maintenance Inspection Schedule

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Start and run for at least 20 minutes each month.
•	•	•	Inspect combustion air intake tube and exhaust pipe for restrictions or blockage.
•	•	•	Inspect ducting, air intake screen, and air outlet for restrictions or blockage.
		•	Remove glow pin and inspect for carbon build up. Clean or replace.
		•	Remove glow pin screen and inspect for carbon build up. Replace.
		•	Change fuel pump screen.

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Sleeper Cab Air Heater Maintenance (D2 shown)

CAUTION: Use fuel suitable for the climate you operate in (see truck engine manufacturer's recommendations). Blending used engine oil with diesel fuel is not permitted in the TriPac system. It will plug the filters and will not allow the air heater to run properly. Thermo King reserves the right to void all warranty on the unit.

- Remove the glow pin screen and inspect for carbon buildup. Clean or replace. See Air Heater Service Operations chapter.
- Make sure vent hole is open. Use non detergent 100% volatile carburetor cleaner. An air gun will also help. Remove loose carbon from the glow pin chamber.
- Inspect the ducting, the air intake screen and air outlet for restriction or blockage.
- Inspect combustion air intake and exhaust for blockage.
- Operate heater for a minimum of 20 minutes each month
- Maintain batteries and all electrical connections in good condition. The heater will not start with insufficient power. Low and high voltage cutouts will shut the heater down automatically.

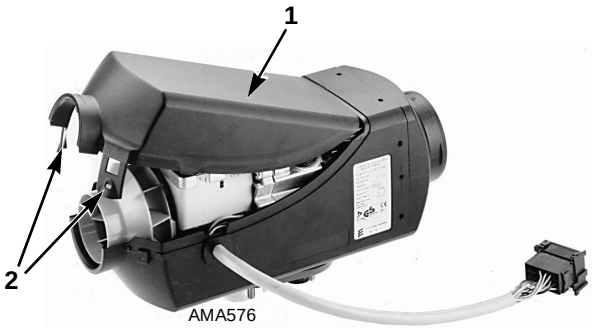
Sleeper Cab Air Heater Service Operations

WARNING: To prevent personal injury, make sure that unit switches are in the Off position before servicing the unit.

CAUTION: Use fuel suitable for the climate you operate in (see truck engine manufacturer's recommendations). Blending used engine oil with diesel fuel is not permitted.

NOTE: The Cab Air Heater contains an EEPROM that monitors the functions and operating status of the air heater's circuitry, inputs & outputs, and components. Whenever a fault occurs, the air heater EEPROM is programmed to recognize dozens of fault codes. The five most-recent fault codes are retained in the EEPROM memory. Older fault codes are deleted from memory as new fault codes occur. Fault codes can be retrieved, in chronological order, and read using a special Fault Reader (TK P/N 204-1143). Complete instructions on the use of the fault code reader and resolution of air heater fault codes are found in the TriPac Operating and Diagnostic Manual, TK 53024.

Remove the Air Heater Cover



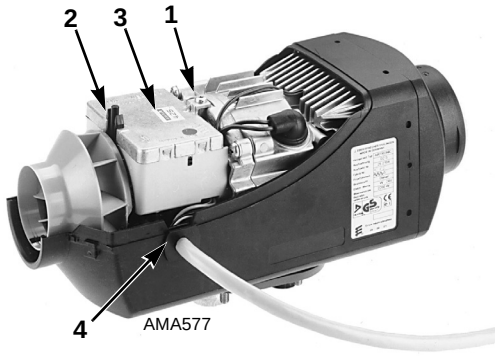
1.	Cover
2.	Seal Plates

Figure 80: Remove Air Heater Cover

NOTE: The cover must always be removed from the heater for all repair stages. You may have to wait for the heater to cool down.

1. Unlock both seal plates, lift cover and pull to the front.
2. The cable harness can exit from the left or right of heater shell.

Removing the Control Unit



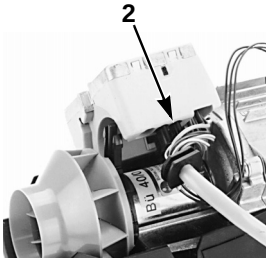
1.	Fastening screw
2.	Retaining brackets
3.	Control unit
4.	Bushing

Figure 81: Removing Control Unit

1. Remove the heater cover.
2. Unscrew fastening screw, press retaining brackets together, lift out control unit.
3. Unclip the lines from the holder of the control unit (observe the positions of the lines).
4. Remove the bushing (lower part) from the outer case.
5. Disconnect the control unit from the controller. The control unit can now be removed.

NOTE: When reassembling the control unit, ensure that the lines are correctly clipped in the holder of the control unit, and that the connectors are plugged into the control unit (non-interchangeable).

Heater Casing Disassembly and Glow Pin Removal



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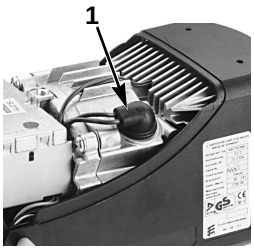

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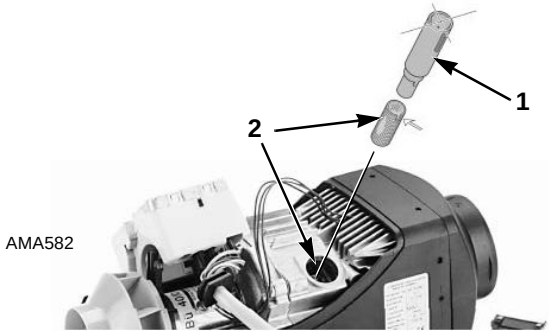
1.	Rubber bushing
2.	Connector of glow pin cable harness
3.	Glow pin
4.	Glow Pin removal tool

Figure 82: Heater Casing Disassembly and Glow Pin Removal

1. Remove the heater cover.
2. Remove the control unit.
3. Disconnect the connector of the glow pin cable harness from the controller.
4. Remove the rubber bushing and use the special tool (SW 12) to unscrew the glow pin. The special tool is included with the glow pin. Tighten torque of the glow pin: 4.8 ft-lb.

NOTE: When the glow pin has been removed, check the lining of the support in installed state for any contamination. The lining must be replaced if the surface is covered with dirt.

Removing the Glow Plug Support Lining



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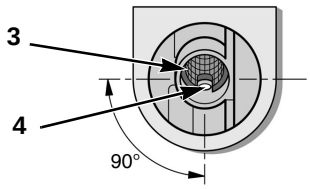

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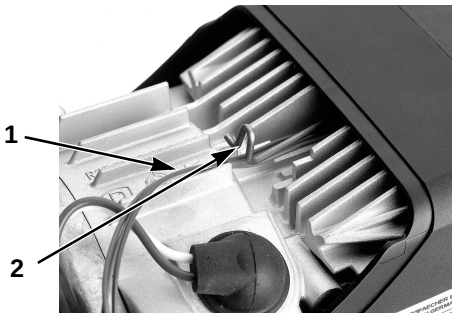
1.	Special tool with lining
2.	Position of recess
3.	Lining
4.	Bore (Ø 2.7 mm) for glow pin ventilation

Figure 83: Removing the Glow Plug Support Lining

1. Pull the lining out of the support with pointed pliers. Blow out the support with compressed air. If necessary, carefully pierce with a wire.
2. The special tool must be used to install the new lining. The special tool is included with the lining. Push the lining onto the special tool, watching the position of the recess. The recess must be positioned at right angles (90°) to the axis of the heater.

   NOTE: The latest version of the lining is shorter and does not have the recess. Therefore, it is not necessary to consider its alignment to the axis of the heater when installing the latest version of the lining (without the recess).
3. Push in the tool with the lining carefully as far as it will go, ensuring that the bore (Ø 2.7 mm) for the glow plug ventilation is free.

Removing the Overheating Sensor / Flame Sensor



1.	Cable harness for overheating/flame sensor
2.	Clip

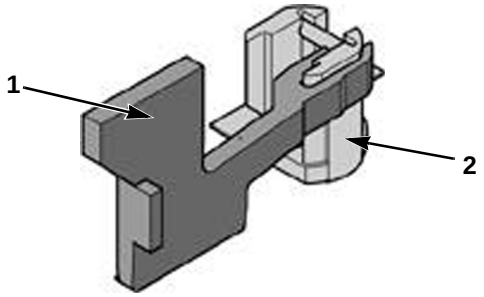
Figure 84: Removing the overheating sensor / flame sensor

1. Remove the heater cover
2. Remove the control unit
3. Disconnect both connectors of the overheating / flame sensor cable harness from the control unit.
4. Unlock clip from sensor.
5. Remove overheating/flame sensor.

Checking the Overheating / Flame Sensor

Observe a maximum temperature of 320° C for checking the sensor.

Overheating Sensor



1.	Special tool
2.	Overheating sensor / flame sensor

Figure 85: Overheating Sensor and Flame Sensor

1. Check the overheating sensor with a digital multimeter. If the resistance value is outside the set point indicated in the values in the table, then the sensor must be replaced. (See table on next page.)

Flame Sensor

1. Check the flame sensor with a digital multimeter. If the resistance value is outside the set point indicated by the values n the table, then the sensor must be replaced. (See table on next page.)

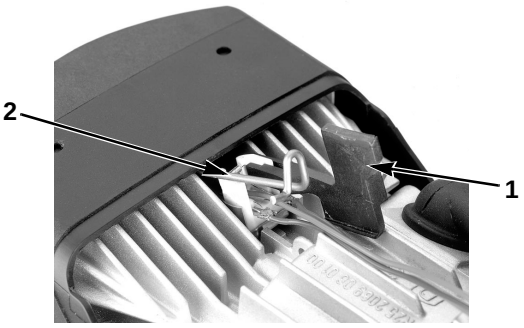
Temp. F	Temp. C	Resistance k ohms Minimum	Resistance k ohms Maximum
-40	-40	1597.0	1919.0
-4	-20	458.8	533.4
32	0	154.7	175.5
68	20	59.3	65.84
104	40	25.02	28.04
140	60	11.56	13.16
176	80	5.782	6.678
212	100	3.095	3.623
248	120	1.757	2.061
284	140	1.050	1.256
320	160	0.665	0.792
356	180	0.425	0.518
392	200	0.285	0.351

Values for Overheat Sensor

Temp. F	Temp. C	Resistance ohms Minimum	Resistance ohms Maximum
-40	-40	825.9	859.6
-4	-20	903.2	940.0
32	0	980.0	1020.0
68	20	1056.4	1099.5
104	40	1132.3	1178.5
140	60	1207.8	1257.1
176	80	1282.8	1335.1
212	100	1357.4	1412.8
248	120	1431.5	1489.9
284	140	1505.1	1566.6
320	160	1578.3	1642.8
392	200	1723.4	1793.7
464	240	1866.6	1942.8
536	280	2008.1	2090.0
608	320	2147.7	2235.4
680	360	2285.5	2378.8
752	400	2421.5	2520.3

Values for Flame Sensor

Installing the Overheating / Flame Sensor



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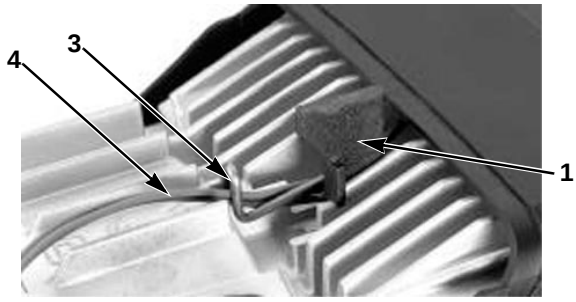

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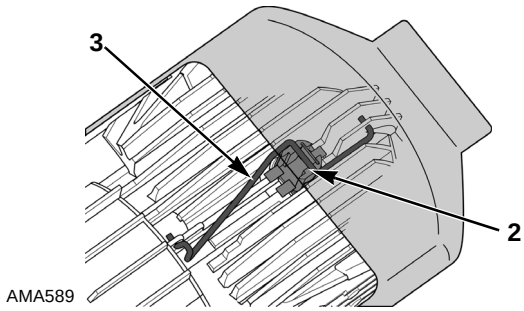
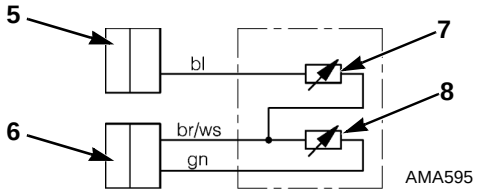


AMA589



AMA595

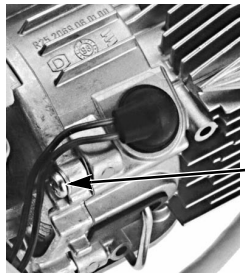
1.	Special tool
2.	Overheating sensor / flame sensor
3.	Clip
4.	Cable harness -overheat/ flame sensor
5.	Connector blue
6.	Connector green
7.	NTC 50 ohm = overheating sensor
8.	PT=flame sensor

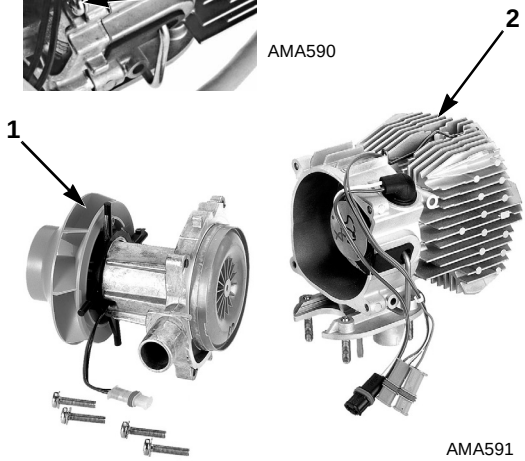
Figure 86: Installing the overheating / flame sensor

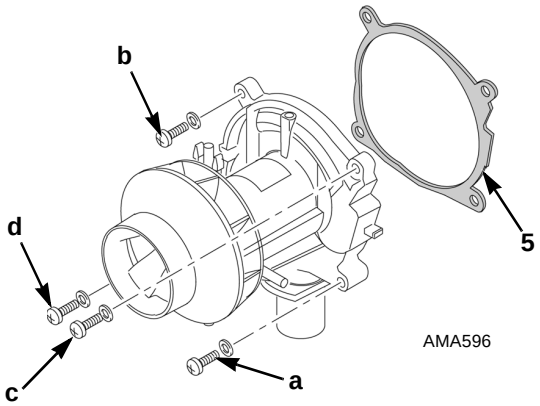
1. Mount the special tool on the sensor

2. Place the sensor on the heat exchanger using the special tool.
3. The special tool slides on the heat exchanger until the sensor meets the collar (installation site of the sensor)
4. Lock the sensor in place and remove the purpose made tool. It is important to make certain that the sensor sits flat on the heat exchanger. If necessary use a mirror and lamp to aid correct assembly.
5. Route the cable harness sensor along the clip eyelet to the control unit and connect.

Dismantling the Heat Exchanger and Removing the Combustion Air Blower







1.	Combustion air blower
2.	Heat exchanger
3.	Fastening screws
4.	a - d: Tighten the fastening screws in this sequence with a tightening torque of 3.3 ft-lb.
5.	Always replace the seal between combustion air blower and heat exchanger

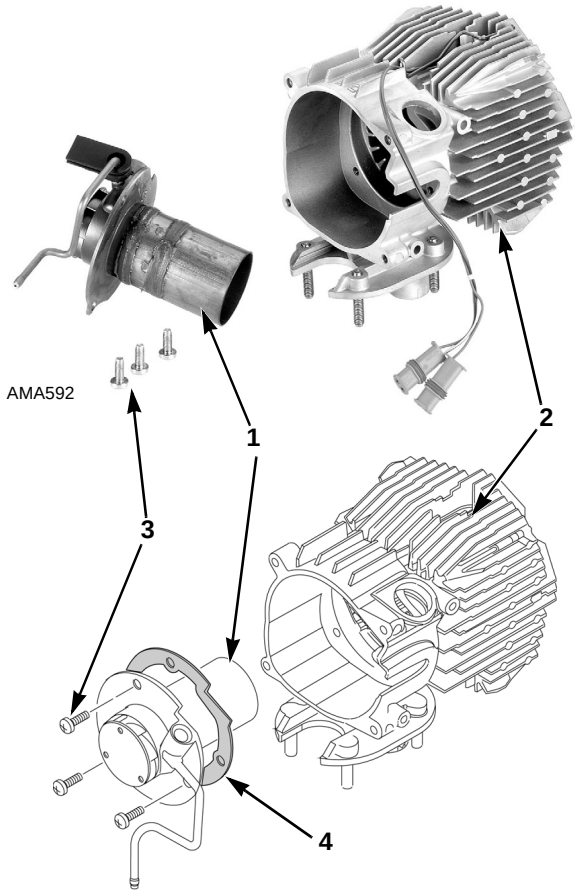
Figure 87: Dismantling the Heat Exchanger and Removing the Combustion Air Blower

1. Remove the heater cover.
2. Remove the control unit.
3. Remove the flange seal.
4. Take the heater out of the outer case (lower part).
5. Unscrew the 4 fastening screws from the combustion air blower.
6. Remove the combustion air blower and the seal from the heat exchanger.

IMPORTANT: When reassembling the combustion air blower a new thermal insulator is always required.

7. Tighten the 4 fastening screws of the combustion air blower in the series shown in the drawing with a tightening torque of 3.3 ft-lb.

Removing the Combustion Chamber



1.	Combustion chamber
2.	Heat exchanger
3.	Fastening screws (3)
4.	Thermal insulator (always replace)

Figure 88: Removing the Combustion Chamber

1. Remove the heater cover.
2. Remove the flange seal.
3. Take the heater out of the outer case (lower part).
   - remove control unit (see previous pages)
   - remove glow pin (see previous pages)
   - remove combustion air blower (see previous pages)
4. Unscrew the 3 fastening screws.
5. Pull the combustion chamber out to the front and remove the seal from the heat exchanger.

NOTE: When reassembling the combustion chamber, the seal, which has been enclosed with the spare part, must always be replaced.

6. Tighten the fastening screws of the combustion chamber with a torque of 4.8 ft-lb.

NOTE: If the heat exchanger is being replaced, the overheating sensor / flame sensor must be dismantled and mounted to the new heat exchanger.

DANGER: Do not use an inverter in life support or health care applications where a malfunction or failure of the inverter could cause failure of a life support device or medical equipment or significantly alter the performance of that equipment.

DANGER: Potentially lethal voltages exist within the inverter as long as the battery supply is connected. During any service work, the battery supply should be disconnected.

DANGER: Do not connect of disconnect batteries while the inverter is operating from the battery supply. Dangerous arcing may result.

CAUTION: Protect against possible electrical shock hazards. If the inverter is operated in wet or damp conditions a user-supplied, portable GFCI (ground fault circuit interruptor) must be connected between each inverter receptacle and the equipment it powers.

CAUTION: You may experience uneven performance results if you connect a surge suppressor, line conditioner or UPS system to the output of the inverter.

Optional Power Inverter

A 12 volt DC to 120 Volt AC inverter is available as an option for TriPac. The inverter is normally connected directly to the truck batteries.

Inverter features will vary, depending upon the brand and model used. Typically, when the inverter detects an AC load, it automatically turns on and converts DC to AC to power onboard 120 Volt devices. If the TriPac is enabled and the inverter draws truck battery voltage down below the voltage limit established for the installation, the TriPac will start and attempt to recharge the truck batteries back to the level specified. If the TriPac is not enabled, the inverter could drain the truck batteries below the level required to start the truck or the TriPac.

Manufacturer’s instructions for the optional inverter are provided separately. It is important to read and follow those instructions for proper use of the inverter.

Maintenance Inspection Schedule

Pre-Trip	500 Hrs	Annual 2,000 Hrs	Check condition of or service the following:
•	•	•	Visually inspect unit for fluid leaks (coolant, oil, refrigerant).
•	•	•	Visually inspect unit for damaged, loose or broken parts.
	•	•	Inspect, clean and (if necessary) replace evaporator air filter. It may be necessary to check or replace it more often if conditions require it.
	•	•	Inspect evaporator drain valves (kazoos) to ensure that they are in place, in good condition and are sealing.
		•	Steam clean condenser and APU pre-cooler coil. Do not bend coil fins.
		•	Blow out evaporator coil and evaporator water drains with air. Do not bend coil fins.
		•	Check APU mounting bolts and brackets for cracks. damage and poor alighment.Verify tightness and torque to 100 ft/lbs (135.6 N•m) for the claw mount, or 200 ft/lbs (271.2 N•m) for the direct frame mount.

WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system.

Evaporator Coil

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., paper or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal air flow. Repair bent fins and any other noticeable damage.

CAUTION: The air pressure should not be high enough to damage coil fins.

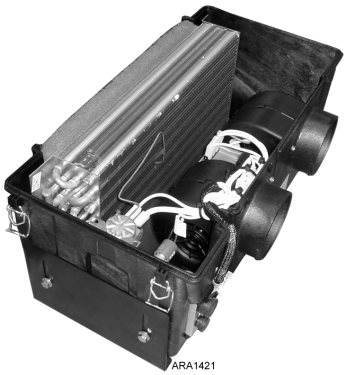
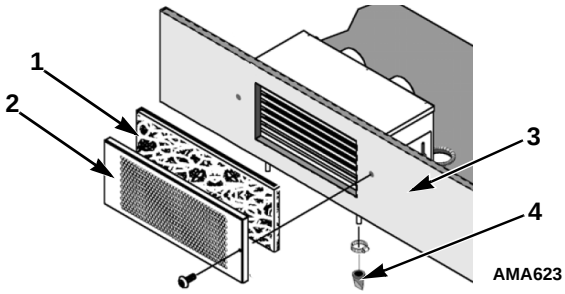


Figure 89: Evaporator (Cover Removed)

Evaporator Coil Air Filter



1.	Evaporator Coil Air Filter
2.	Air Filter Cover
3.	Front of Sleeper Compartment Bunk
4.	Evaporator Drain Valve (Kazoo)

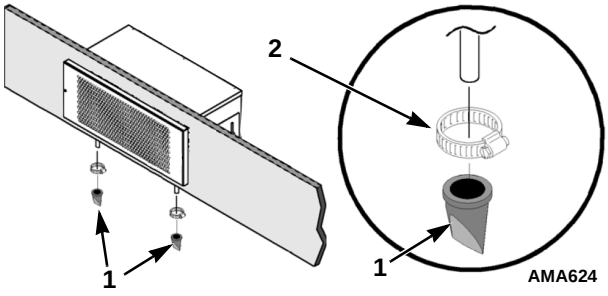
Figure 90: Evaporator Coil Air Filter

The evaporator coil air filter is accessible from inside the truck cab sleeper compartment.

1. Unscrew filter cover and remove the filter.
2. Using compressed air, blow in the direction opposite normal air flow to remove accumulated dust.

3. Wash filter material in warm soapy water. Flush water in the direction opposite to normal air flow.
4. Remove excess water and install filter. Replace filter if necessary.
5. Replace and secure filter cover.

Evaporator Drain Valves



1.	Evaporator Drain Valve
2.	Evaporator Drain Valve Clamp

Figure 91: Drain Valves

Two evaporator coil drain valves (“kazoos”) are accessible under the truck cab sleeper compartment exterior. Inspect each evaporator coil drain valve to ensure that they each have a rubber check valve in place. Missing or damaged evaporator drain check valves may allow air to be drawn up the drains and prevent evaporator condensate water from draining. Also, dirt and engine fumes may be drawn up the drains. Install new check valves if they are missing. Replace them if they are damaged or hardened.

Loosen and remove the drain valve clamps to replace the drain valves.

Condenser Coil

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal air flow. Repair bent fins and any other noticeable damage.

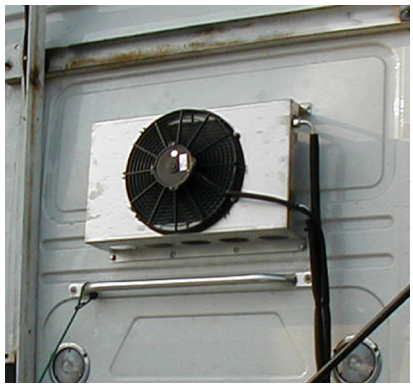


Figure 92: Condenser

APU Mounting Bolts

Check during the pretrip inspection for damaged, loose or broken parts. Torque the unit mounting bolts yearly to 100 ft/lbs (135.6 N•m) for the claw mount, or 200 ft/lbs (271.2 N•m) for the direct frame mount.

TriPac System Components Diagram

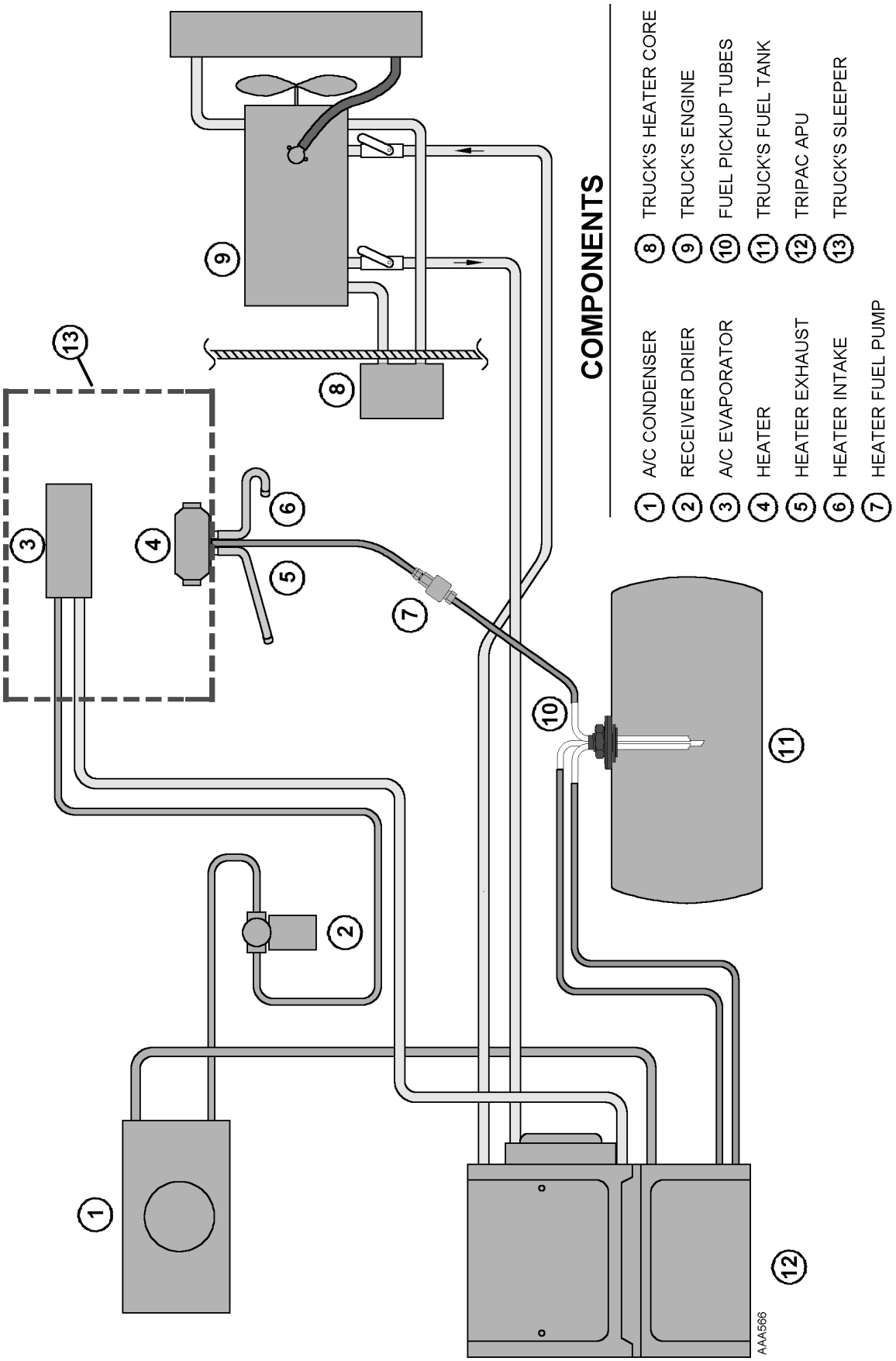


Figure 93: TriPac System Components

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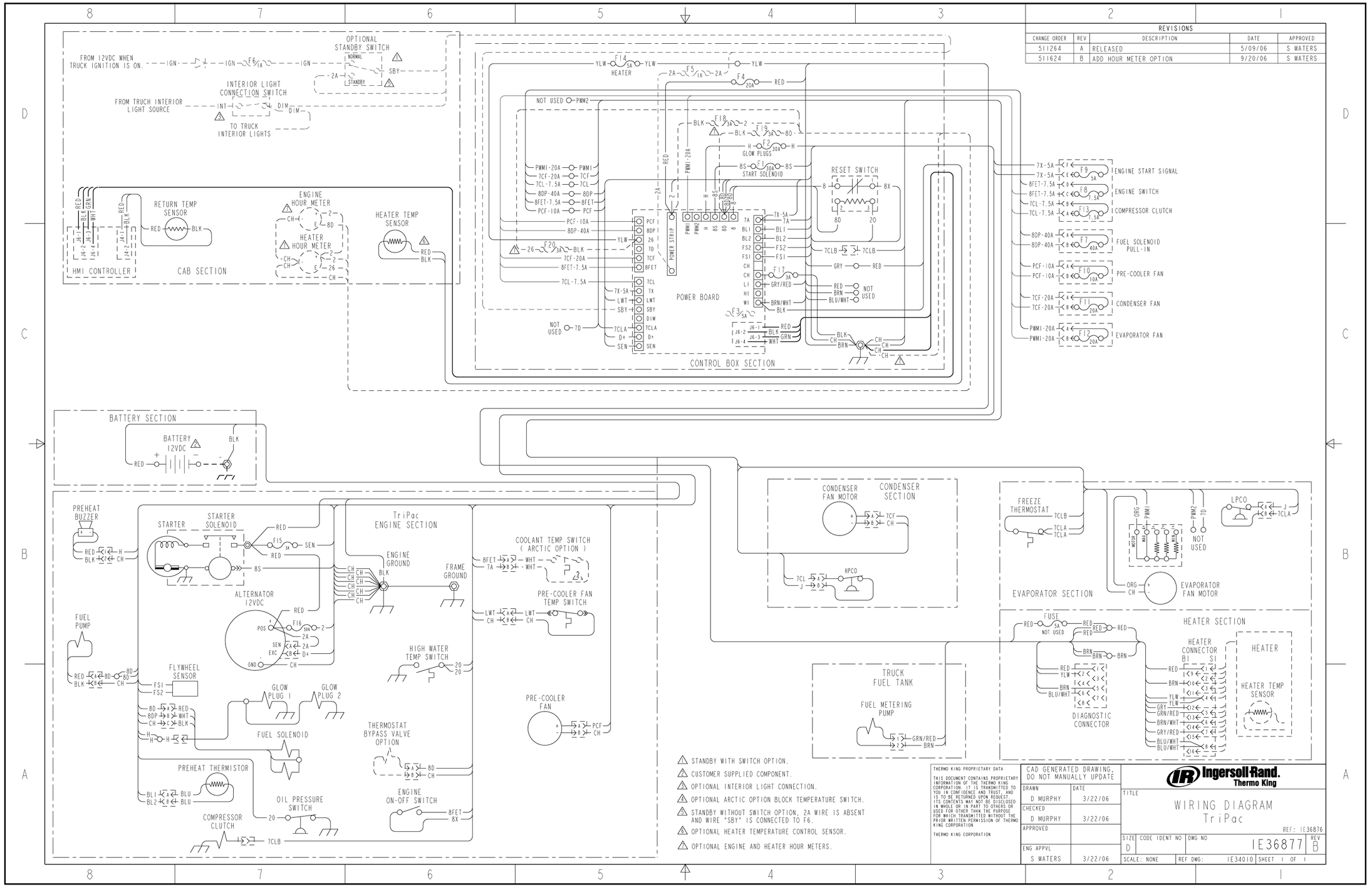
TriPac Wiring Diagram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511624 | B | ADD HOUR METER OPTION | 9/20/06 | S WATERS
OPTIONAL STANDBY SWITCH
FROM 12VDC WHEN TRUCK IGNITION IS ON.
INTERIOR LIGHT CONNECTION SWITCH
FROM TRUCH INTERIOR LIGHT SOURCE
TO TRUCK INTERIOR LIGHTS
HEATER
GLOW PLUGS
START SOLENOID
RESET SWITCH
POWER BOARD
POWER STRIP
CONTROL BOX SECTION
ENGINE START SIGNAL
ENGINE SWITCH
COMPRESSOR CLUTCH
FUEL SOLENOID PULL-IN
PRE-COOLER FAN
CONDENSER FAN
EVAPORATOR FAN
HM1 CONTROLLER
CAB SECTION
RETURN TEMP SENSOR
ENGINE HOUR METER
HEATER HOUR METER
HEATER TEMP SENSOR
BATTERY SECTION
BATTERY 12VDC
PREHEAT BUZZER
STARTER
STARTER SOLENOID
TriPac ENGINE SECTION
ENGINE GROUND
FRAME GROUND
COOLANT TEMP SWITCH (ARCTIC OPTION)
ALTERNATOR 12VDC
PRE-COOLER FAN TEMP SWITCH
FUEL PUMP
FLYWHEEL SENSOR
HIGH WATER TEMP SWITCH
GLOW PLUG 1
GLOW PLUG 2
FUEL SOLENOID
THERMOSTAT BYPASS VALVE OPTION
PREHEAT THERMISTOR
OIL PRESSURE SWITCH
ENGINE ON-OFF SWITCH
COMPRESSOR CLUTCH
CONDENSER FAN MOTOR
CONDENSER SECTION
HPCO
TRUCK FUEL TANK
FUEL METERING PUMP
FREEZE THERMOSTAT
LPCO
EVAPORATOR SECTION
EVAPORATOR FAN MOTOR
HEATER SECTION
FUSE
HEATER CONNECTOR
DIAGNOSTIC CONNECTOR
1 STANDBY WITH SWITCH OPTION.
2 CUSTOMER SUPPLIED COMPONENT.
3 OPTIONAL INTERIOR LIGHT CONNECTION.
4 OPTIONAL ARCTIC OPTION BLOCK TEMPERATURE SWITCH.
5 STANDBY WITHOUT SWITCH OPTION, 2A WIRE IS ABSENT AND WIRE "SBY" IS CONNECTED TO F6.
6 OPTIONAL HEATER TEMPERATURE CONTROL SENSOR.
7 OPTIONAL ENGINE AND HEATER HOUR METERS.
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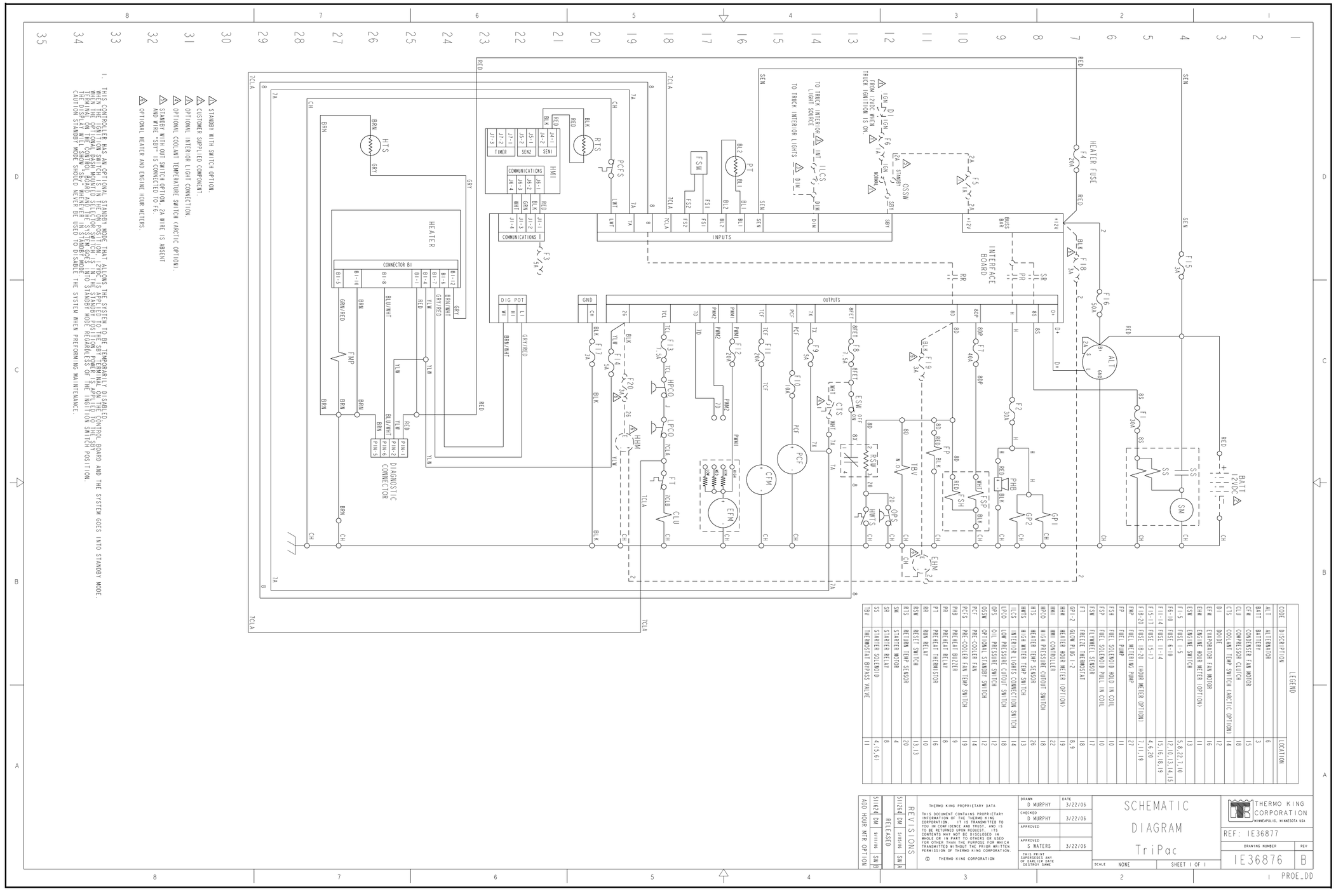
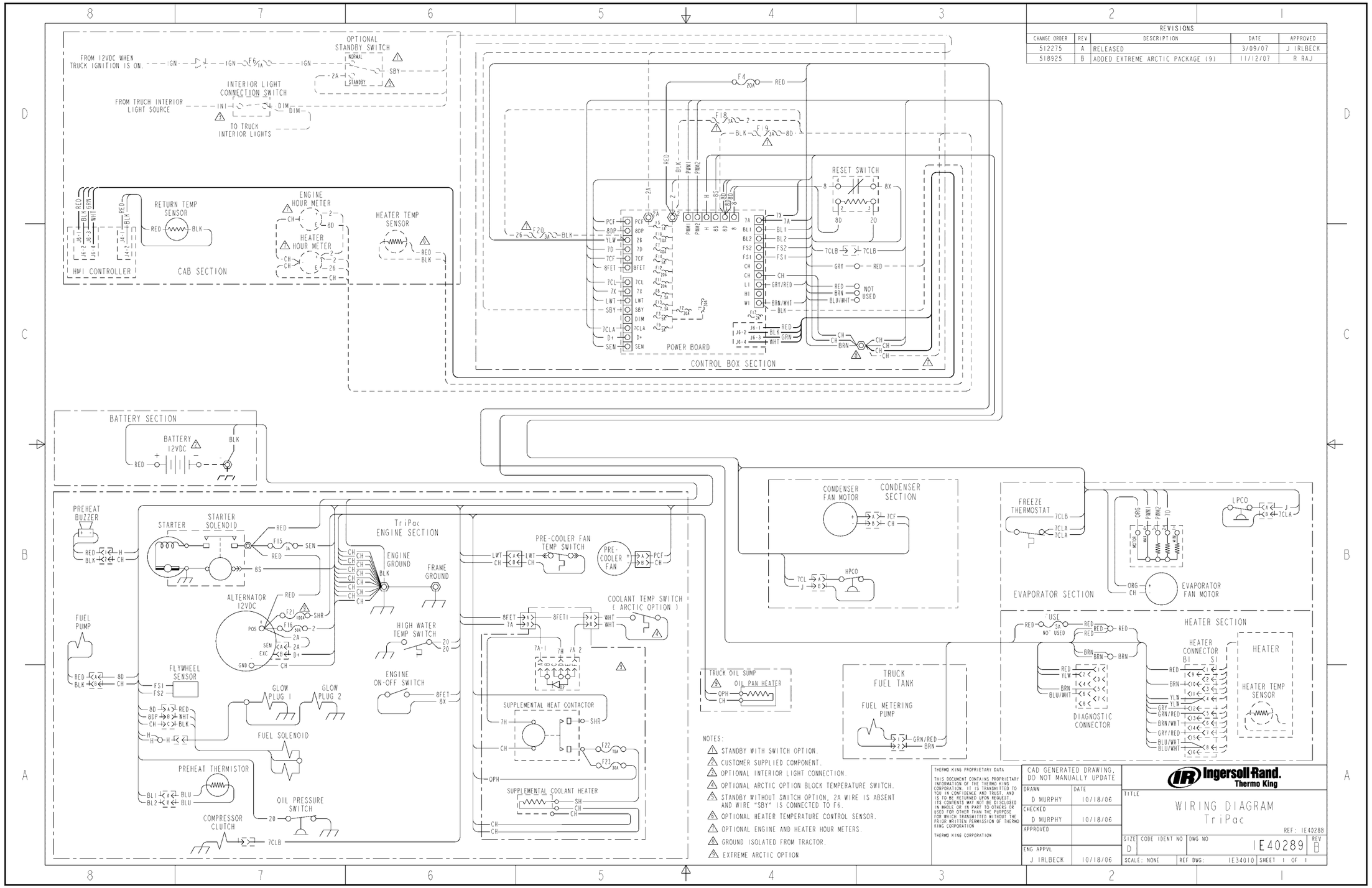
SCALE: NONE | REF DWG: IE34010 | SHEET 1 OF 1

TriPac Schematic Diagram



TriPac Wiring Diagram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518925 | B | ADDED EXTREME ARCTIC PACKAGE (9) | 11/12/07 | R RAJ
OPTIONAL STANDBY SWITCH
FROM 12VDC WHEN TRUCK IGNITION IS ON.
INTERIOR LIGHT CONNECTION SWITCH
FROM TRUCH INTERIOR LIGHT SOURCE
TO TRUCK INTERIOR LIGHTS
HMI CONTROLLER
CAB SECTION
RETURN TEMP SENSOR
ENGINE HOUR METER
HEATER HOUR METER
HEATER TEMP SENSOR
POWER BOARD
CONTROL BOX SECTION
RESET SWITCH
NOT USED
BATTERY SECTION
BATTERY 12VDC
PREHEAT BUZZER
STARTER
STARTER SOLENOID
TriPac ENGINE SECTION
ENGINE GROUND
FRAME GROUND
ALTERNATOR 12VDC
FUEL PUMP
FLYWHEEL SENSOR
GLOW PLUG 1
GLOW PLUG 2
FUEL SOLENOID
PREHEAT THERMISTOR
OIL PRESSURE SWITCH
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ENGINE ON-OFF SWITCH
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PRE-COOLER FAN
COOLANT TEMP SWITCH (ARCTIC OPTION)
SUPPLEMENTAL HEAT CONTACTOR
SUPPLEMENTAL COOLANT HEATER
TRUCK OIL SUMP
OIL PAN HEATER
CONDENSER FAN MOTOR
CONDENSER SECTION
HPCO
TRUCK FUEL TANK
FUEL METERING PUMP
FREEZE THERMOSTAT
LPCO
EVAPORATOR SECTION
EVAPORATOR FAN MOTOR
HEATER SECTION
HEATER CONNECTOR
HEATER
HEATER TEMP SENSOR
DIAGNOSTIC CONNECTOR
NOTES:
1. STANDBY WITH SWITCH OPTION.
2. CUSTOMER SUPPLIED COMPONENT.
3. OPTIONAL INTERIOR LIGHT CONNECTION.
4. OPTIONAL ARCTIC OPTION BLOCK TEMPERATURE SWITCH.
5. STANDBY WITHOUT SWITCH OPTION, 2A WIRE IS ABSENT AND WIRE "SBY" IS CONNECTED TO F6.
6. OPTIONAL HEATER TEMPERATURE CONTROL SENSOR.
7. OPTIONAL ENGINE AND HEATER HOUR METERS.
8. GROUND ISOLATED FROM TRACTOR.
9. EXTREME ARCTIC OPTION
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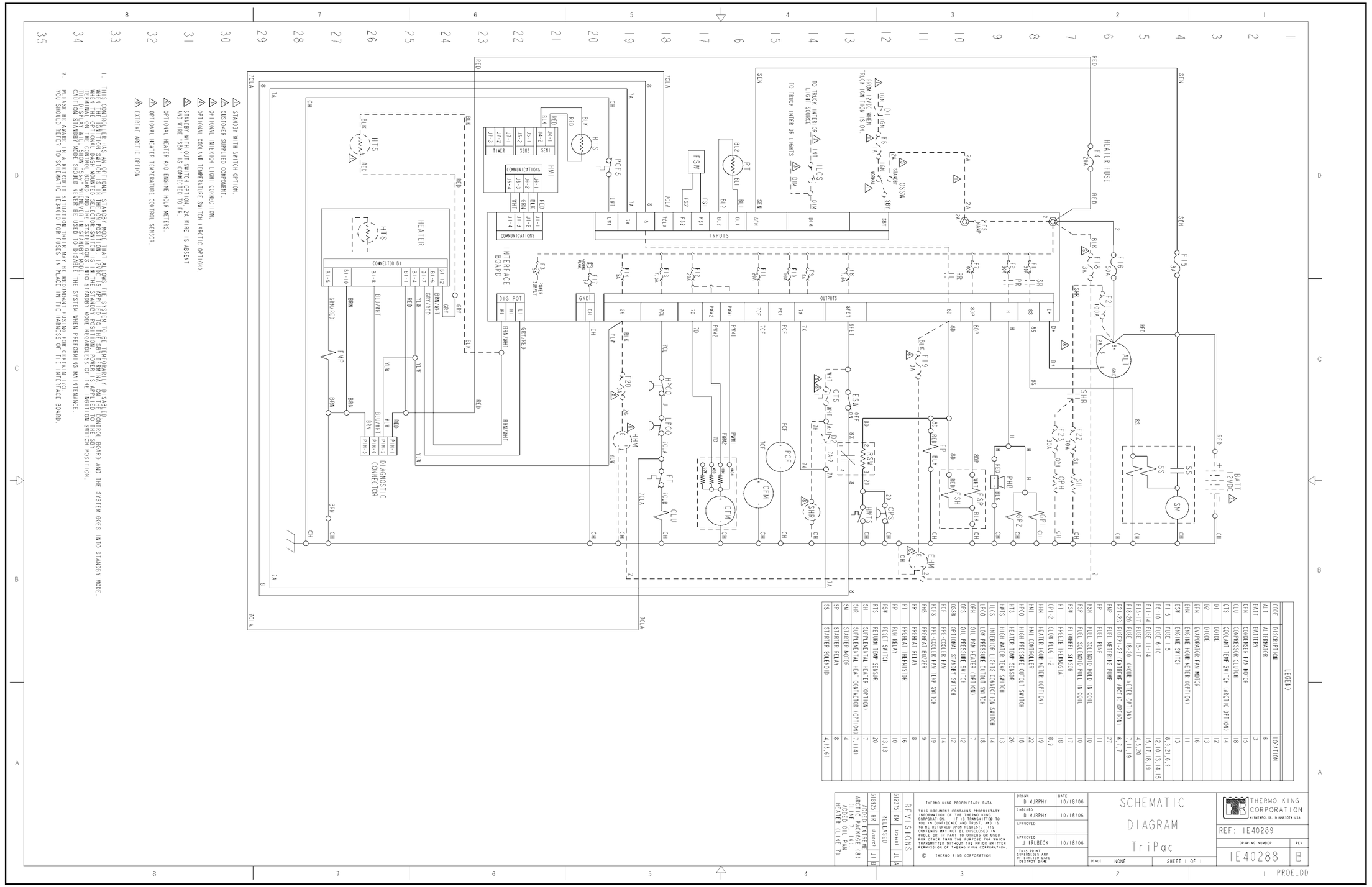
APPROVED
ENG APPVL J IRLBECK 10/18/06
Ingersoll-Rand. Thermo King
TITLE
WIRING DIAGRAM
TriPac
REF: IE40288
SIZE D | CODE IDENT NO | DWG NO IE40289 | REV B
SCALE: NONE | REF DWG: IE34010 | SHEET 1 OF 1

TriPac Schematic Diagram


1. THIS CONTROLLER HAS AN OPTIONAL STANDBY MODE THAT ALLOWS THE SYSTEM TO BE TEMPORARILY DISABLED WHEN THE IGNITION SWITCH IS IN THE OFF POSITION. WITH THE STANDBY OPTION INSTALLED, 12VDC APPLIED TO THIS TERMINAL ON THE CONTROL BOARD AND THE SYSTEM GOES INTO STANDBY MODE REGARDLESS OF THE IGNITION SWITCH POSITION.
CAUTION: STANDBY MODE SHOULD NEVER BE USED TO DISABLE THE SYSTEM WHEN PERFORMING MAINTENANCE.
2. PLEASE REFER TO A CHERRY SITUATION WHERE MAY BE USED FOR FAILURES IN THE HARNESS OR THE INTERFACE BOARD.
STANDBY WITH SWITCH OPTION.
CUSTOMER SUPPLIED COMPONENT.
OPTIONAL INTERIOR LIGHT CONNECTION.
OPTIONAL COOLANT TEMPERATURE SWITCH (ARCTIC OPTION).
STANDBY WITHOUT SWITCH OPTION. 24 WIRE IS ABSENT AND WIRE "SBY" IS CONNECTED TO 16.
OPTIONAL HEATER AND ENGINE HOUR METERS.
OPTIONAL HEATER TEMPERATURE CONTROL SENSOR.
EXTREME ARCTIC OPTION.
HEATER
CONNECTOR B1
DIAGNOSTIC CONNECTOR
COMMUNICATIONS
INTERFACE BOARD
DIG POT
GND1
INPUTS
OUTPUTS
HEATER FUSE
BATT 12VDC
SM
CFM
EFM
HPCO
LPCO
CTS
FSW
PCF
PT
RTS
HTS
HWTS
ILCS
OPH
OPS
OSSW
PHB
PCFS
PR
RR
RSW
SHR
SM
SR
SS
LEGEND
CODE
DESCRIPTION
LOCATION
ALT ALTERNATOR 6
BATT BATTERY 3
CFM CONDENSER FAN MOTOR 15
CLU COMPRESSOR CLUTCH 18
CTS COOLANT TEMP SWITCH (ARCTIC OPTION) 14
DI DIODE 12
D2 DIODE 13
EFM EVAPORATOR FAN MOTOR 16
EHM ENGINE HOUR METER (OPTION) 11
ESW ENGINE SWITCH 13
F1-5 FUSE 1-5 8,9,21,6,9
F6-10 FUSE 6-10 12,10,13,14,15
F11-14 FUSE 11-14 15,17,18,19
F15-17 FUSE 15-17 4,5,20
F18-20 FUSE 18-20 (HOUR METER OPTION) 7,11,19
F21-23 FUSE21-23 (EXTREME ARCTIC OPTION) 6,7,1
FMP FUEL METERING PUMP 27
FP FUEL PUMP 11
FSH FUEL SOLENOID HOLD IN COIL 10
FSP FUEL SOLENOID PULL IN COIL 10
FSW FLYWHEEL SENSOR 17
FT FREEZE THERMOSTAT 18
GP1-2 GLOW PLUG 1-2 8,9
HHM HEATER HOUR METER (OPTION) 19
HMI HMI CONTROLLER 22
HPCO HIGH PRESSURE CUTOUT SWITCH 18
HTS HEATER TEMP SENSOR 26
HWTS HIGH WATER TEMP SWITCH 13
ILCS INTERIOR LIGHTS CONNECTION SWITCH 14
LPCO LOW PRESSURE CUTOUT SWITCH 18
OPH OIL PAN HEATER (OPTION) 7
OPS OIL PRESSURE SWITCH 12
OSSW OPTIONAL STANDBY SWITCH 12
PCF PRE-COOLER FAN 14
PCFS PRE-COOLER FAN TEMP SWITCH 13
PHB PREHEAT BUZZER 9
PR PREHEAT RELAY 8
PT PREHEAT THERMISTOR 16
RR RUN RELAY 10
RSW RESET SWITCH 13,13
RTS RETURN TEMP SENSOR 20
SH SUPPLEMENTAL HEATER (OPTION) 7
SHR SUPPLEMENTAL HEAT CONTACTOR (OPTION) 7,14)
SM STARTER MOTOR 4
SR STARTER RELAY 8
SS STARTER SOLENOID 4,5,6)
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REVISIONS
512275 DM 3/09/07 JL A
518925 RR 12/19/07 JJ B
ADDED EXTREME ARCTIC OPTION (LINE 8)
ADDED 7, 14).
ADDED OIL PAN HEATER (LINE 7)
RELEASED
DRAWN D MURPHY DATE 10/18/06
CHECKED D MURPHY 10/18/06
APPROVED
APPROVED J IRLBECK 10/18/06
THIS PRINT SUPERSEDES ANY EARLIER DATE DESTROY SAME
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